BOSTON, MA 02116

STUDY DESIGN

FOR A BALANCED TRANSPORTATION DEVELOPMENT PROGRAM

FOR THE BOSTON METROPOLITAN REGION

PREPARED FOR GOVERNOR FRANCIS W. SARGENT
UNDER THE DIRECTION OF THE
STEERING GROUP ON THE
BOSTON TRANSPORTATION PLANNING REVIEW

CONSULTANT: SYSTEM DESIGN CONCEPTS, INC.

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NOVEMBER 1970

THE COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE DEPARTMENT

STATE HOUSE • BOSTON 02133

FRANCIS W. SARGENT
GOVERNOR

December 1, 1970

Governor Francis W. Sargent
State House
Boston, Massachusetts

Dear Governor Sargent:

It is my great pleasure to transmit this study design for the Boston Transportation Planning Review to you. It is the product of intensive participation over the past four months by representatives of your office, ten other state agencies, nine localities, and a variety of private associations.

The study design process began during August with discussions of numerous memoranda from the participants expressing their priorities and proposals for the Planning Review. After several weeks, the consultant staff began to submit memoranda which sought to synthesize the various participant views and to pose difficult questions on which guidance would be required before an adequate study design could be drafted. At the end of September, the staff did produce a complete working draft. Following intensive discussion, a completely revised second draft was submitted to the participants in late October. Their suggestions for revision have, insofar as possible, been incorporated in the present version.

Needless to say, the participants are not unanimous in endorsing every aspect of this study design. Broad agreement on what the Planning Review should do, and how, does seem to have been achieved, however. And a basic confidence has been established that the Review will proceed without preconceptions, that it will openly and dispassionately evaluate all reasonable alternatives in the service of your quest for a Balanced Transportation Development Program.

As you know, the services of the study design consultant, System Design Concepts, Inc., have been financed by the Massachusetts Department of Public Works. The Commonwealth's study management effort has been financed cooperatively by the Governor's Office, the Massachusetts Bay Transportation Authority, and the Metropolitan District Commission.

During the course of the study design effort, contact has been maintained with representatives of Secretary Volpe's office, the Federal Highway Administration, and the Urban Mass Transportation Administration. A number of these officials have reviewed early drafts of the study design and their comments have been most helpful.

I look forward to working with you in the implementation of this study design. It promises, I believe, that the Boston Transportation Planning Review will provide you in timely fashion with the advice and analyses you have requested, and that it will provide a useful prototype for future comprehensive transportation planning in the Commonwealth.

Sincerely,

Alan Altshuler

Alan Altshuler, Director
Boston Transportation Planning Review

AA:bwp

STEERING GROUP

of the Study Design for the
BOSTON TRANSPORTATION PLANNING REVIEW

(*) Alan A. Altshuler, Chairman
Office of the Governor

(Principal representatives only are listed; alternates and other members of delegations have been omitted from this list. Asterisk(*) denotes membership on Working Committee as well as Steering Group.)

Municipalities

Boston	(*)	Robert H. Murphy
Brookline		John E. Woodward, Jr.
Cambridge	(*)	Tunny Lee
		(James Morey, until 9/1/70)
Canton		Paul K. Lambert
Dedham		Paul F. Lawler
Milton	(*)	Roger Nicholas
Needham		Henry D. Hersey
Newton		Michael Ferris
Somerville		Miss Carla Johnston

(Revere, Saugus, and Winthrop were also invited to participate in the Study Design phase, but decided to postpone intensive participation until the study itself is underway.)

State Agencies

Governor's Office		Guy D. Rosmarin
Mass Bay Transportation Authority	(*)	Donald M. Graham
Mass. Dept. of Administration and Finance		Michael M. Bernard
Mass. Dept. of Community Affairs		George Thomson
Mass. Dept. of Natural Resources		Evans C. Hawes
Mass. Dept. of Public Works	(*)	Leo F. DeMarsh
Mass. Port Authority		Thomas P. Callaghan
Mass. Turnpike Authority		Lawrence E. Ryan
Metropolitan Area Planning Council	(*)	Paul E. McBride
Metropolitan District Commission	(*)	Stephen Kaiser
		(Stephen Crosby until 10/1/70)

Private Groups (Total of 9 representatives to date)

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Greater Boston	(*)	William F. Chouinard
Conservation/Environmental Coalition	(*)	Thomas S. Kohlsaat
(Charles River Watershed Assn.		Dr. Herbert M. Meyer
(Mass. Conservation Council		
(Mass. Forest and Park Assn.		
(Mystic River Basin Assn.		
(Neponset Conservation Assn.		
Greater Boston Committee on the Transportation Crisis		
Chairman	(*)	Fr. John Hinckley
		(Fr. Thomas Corrigan until 9/1/70)
Operation STOP	(*)	Charles Turner
Negotiating Staff		Dr. Arthur Katz
		Brad Yoneoka
		Stephen Zecker

Principal Observers

U.S. Federal Highway Administration	Philip Robinson
Joint Committee on Transportation, Mass. General Court	Miss Dawn-Marie Driscoll
League of Women Voters	
Boston	Mrs. Ila Cooper
Cambridge	Miss Deborah Lamb
Boston Society of Architects	Peter W. Roudebush

Consultant

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in association with:	
- Skidmore, Owings, & Merrill	
- Marcou, O'Leary & Associates, Inc.	
- E.S. Preston Associates, Inc.	

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COMMONWEALTH OF MASSACHUSETTS

STUDY DESIGN

for a

BALANCED TRANSPORTATION DEVELOPMENT PROGRAM

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Prepared for

GOVERNOR FRANCIS W. SARGENT

under the direction of the

STEERING GROUP

of the

BOSTON TRANSPORTATION PLANNING REVIEW

CONSULTANT: SYSTEM DESIGN CONCEPTS, INC.

NOVEMBER, 1970

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INTRODUCTION AND SUMMARY

The Boston Transportation Planning Review has been established by Governor Francis W. Sargent to advise him on a number of major transportation controversies within that portion of the Boston metropolitan region bounded by Route 128. Governor Sargent has directed that these controversies be reviewed in concert, with careful attention to their interrelationships and to their impacts upon the full range of metropolitan values. To this end, he has also directed that the Planning Review process be open and broadly participatory, so as adequately to reflect the values, priorities, and proposals that the region's public agencies, private institutions, and voluntary associations may wish to contribute.

The controversies on which the Planning Review will focus concern the proposed construction of a number of new limited access expressways and rapid transit extensions, in particular:

The Inner Belt (I-695)

The Southwest Expressway (I-95 South)

The Southwest rapid transit extension

The Route 2 extension from Alewife to the Inner Belt

The Harvard-Alewife transit extension

Relocated I-95, including the Third Harbor Tunnel

The Planning Review is geared to take 18 months. Its aim is to advise the Governor and his Secretary of Transportation on whether and how to seek implementation of these projects, taking into account their feasibility and all their relevant impacts, together with those of alternative proposals that command substantial support within the region.

Where disagreement among the participants persists at the conclusion of the Planning Review, a well-developed set of alternatives will be presented to the Governor and Secretary, accompanied by a thorough analysis of the advantages and disadvantages of each.

This design for the Planning Review has been prepared in two parts.

Part I describes the Planning Review as a whole -- its purpose and orientation, its organization and participatory mechanisms, its work program, the criteria to be used in comparing alternatives, and the alternatives themselves.

Part II sets forth in detail the work elements to be accomplished, and includes more detailed budget and scheduling estimates.

A summary follows. It is divided into seven sections:

I. Study Plan for a Balanced Transportation Development Program

II. Overview of the Planning and Decision Making Process

III. Work Program and Study Process

IV. Criteria

V. Alternatives

VI. Study Elements

VII. Budget Summary by Study Element and Phase

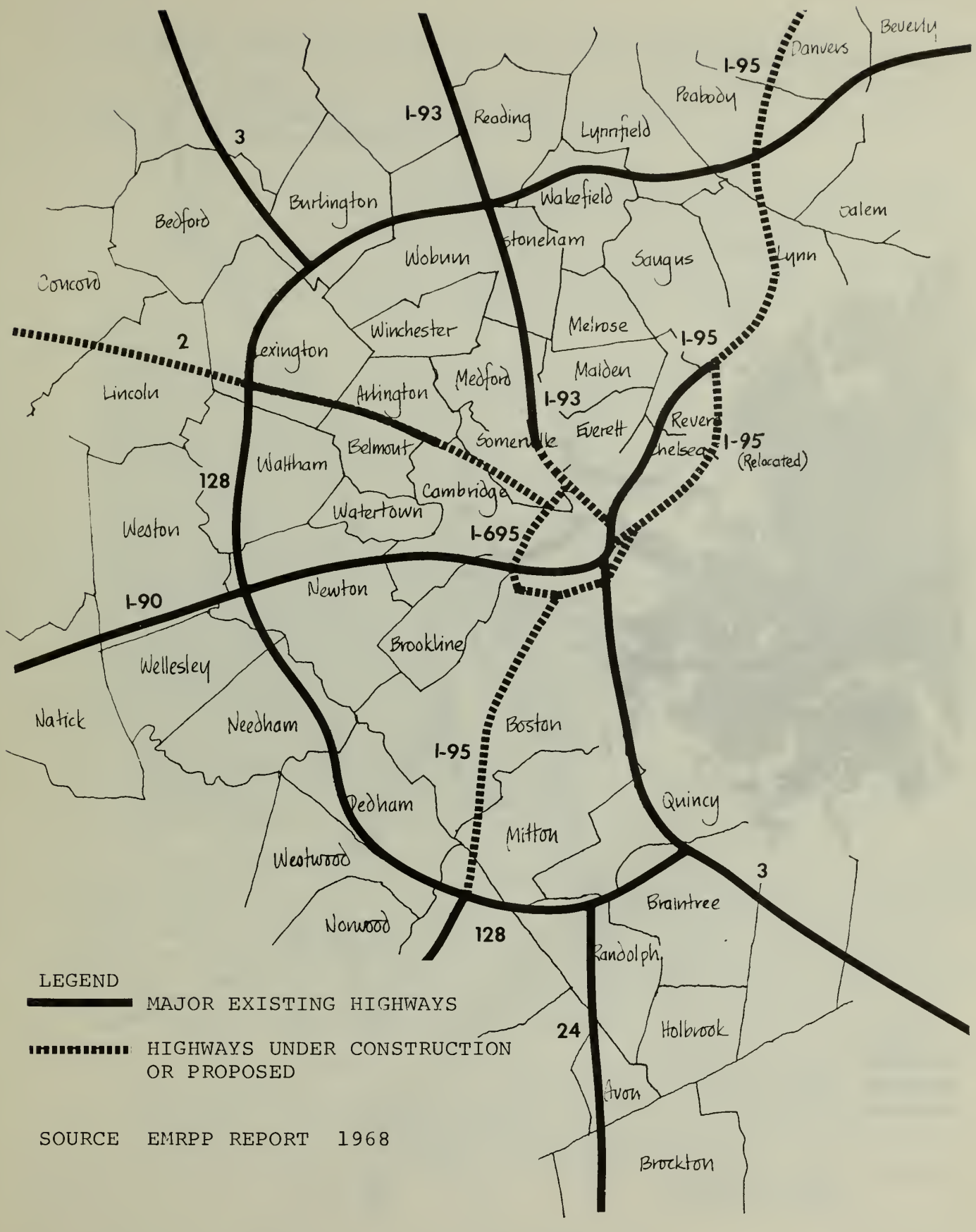

Figure V.1 RECOMMENDED HIGHWAY PLAN (EMRPP 1968)

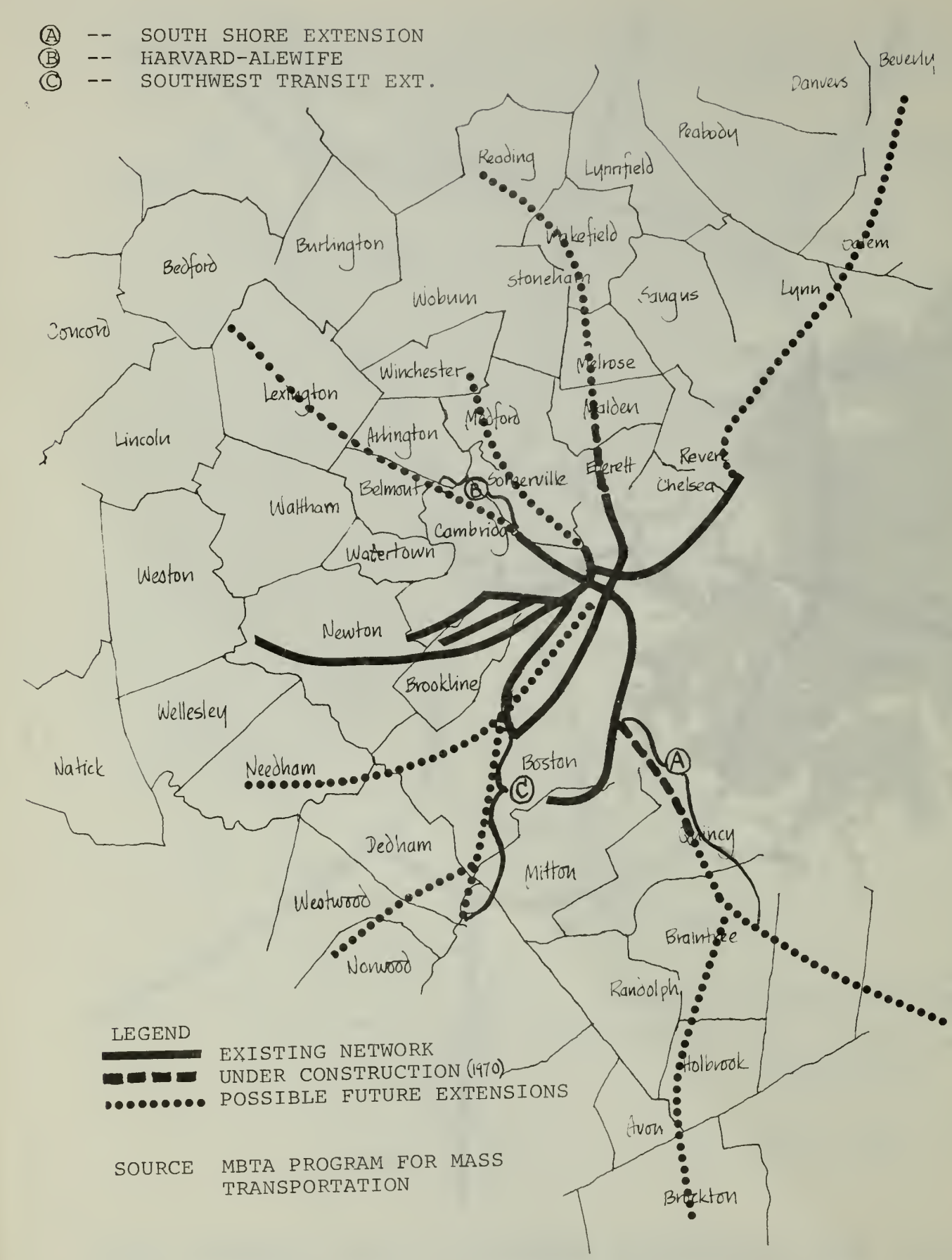

Figure V.2 RECOMMENDED TRANSIT PLAN (EMRPP 1968)

I. Study Plan for a Balanced Transportation Development Program.

This Study Plan is a response to the challenge and opportunity facing Massachusetts. In the words of Governor Sargent's Task Force on Transportation:

> "The Boston region is at a crossroads in transportation policy. Critical investment choices have to be made in the near future. Dissatisfaction with the existing transportation decision process, and with its products, is rife. And there is a widespread willingness to consider fundamental changes in the organization and philosophy of transportation decision making.
>
> "This willingness to consider fundamental change has been shaped by two major crises: on the one hand, the fiscal crisis of public transportation; on the other, growing resistance to the deleterious by-products of private transportation -- most notably, those of the new urban expressways that have been planned to accommodate the private car.
>
> "Both crises have reached a new peak of intensity at a time when fundamental reorganization of the state government is already under way. In April 1971, nearly all state agencies are to be brought within ten Executive Offices, all headed by gubernatorial appointees who will collectively constitute a Governor's Cabinet. One of these new offices will be the Executive Office of Transportation and Construction. Its Secretary will have an opportunity for multi-modal policy leadership that no state official has ever had previously.
>
> "...If (this opportunity) is exploited effectively, we believe the current transportation crises will be viewed in future years as having laid the groundwork for an era of great and genuine transportation progress." 1/

The study plan which follows has been designed fully to exploit this opportunity. The objective is to use transportation decisions and other closely related actions to preserve and enhance the natural and man-made environment; to improve the quality, vitality and integrity of neighborhoods; to retain and increase needed jobs in inner city areas; to reverse the deteriorating housing market conditions of older communities which have been impacted by previous transportation decisions; to improve the mobility of all

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1/ Governor's Task Force on Transportation, "Report to Governor Sargent, Part II," June 1970, p. 1.

citizens; and to speed the flow of goods so necessary to the metropolitan economy.

The Study Plan builds upon the significant advances which have been made in past transportation planning activities in the Boston metropolitan area, and fully recognizes both the letter and the spirit of dynamic new policies and programs which offer the opportunity to bring about more comprehensive urban transportation planning.

When viewed from today's perspective, previous planning has a number of shortcomings which require correction.

The most recent and most comprehensive transportation planning effort was the Eastern Massachusetts Regional Planning Project (EMRPP), a cooperative effort of the principal state agencies concerned with transportation and all Boston area municipalities through the Metropolitan Area Planning Council. It led the nation in the development of some of its advanced planning techniques. It closely integrated highway and transit planning for the first time. Its adopted comprehensive set of goals, objectives and policies formally recognized the drastic changes taking place in public attitudes and the new policy orientation of Federal, State, and local governments giving increasing emphasis to social, economic and environmental values and impacts.

However, the EMRPP accepted as committed the prior highway and transit plans for the area inside of Route 128 -- a highway plan developed immediately after World War II and a transit plan whose origins lay in the 1959 to 1962 period -- and gave primary emphasis to suburban-downtown service improvements and extensions.

Since the framework for the EMRPP was established in the early 1960's, a number of questions and controversies regarding the environmental and social impacts of these older designs have been raised. A serious housing crisis has developed. Tax losses, noise, air pollution, and traffic in neighborhoods have all become major concerns of core area communities.

Many potentially promising new approaches to the solution of these problems have developed and need to be examined in this study. Changes in the patterns of the region's development, and increased understanding of the functioning and the role of transportation, have led to a need to reexamine certain features of prior plans. Many other reasons can be given.

Most importantly, public attitudes and public policy, particularly regarding the environment, employment, taxes, housing, social disruption, and mobility for all citizens, have changed

drastically while transportation plans, especially for the core of the region, have remained virtually unchanged.

In response to expressed dissatisfaction over these conditions, Governor Sargent appointed a Task Force in 1969 to begin a fundamental reexamination of the Commonwealth's transportation plans and policies. Acting on its recommendations, he announced in February 1970 that he was making major changes in transportation policy.

Design work and land acquisition were suspended on certain highway segments within Route 128. A reexamination of plans for the region within Route 128 was required, for both transit and highways. A new planning process was to be initiated, aimed at a balanced transportation development program -- a process which would plan for the future based upon recently established and newly emerging policies of both the Commonwealth and the Federal Government. The study design period has been the beginning of this new process.

Planning is to incorporate a genuine integration of social, environmental, economic and transportation criteria. Assumptions, options and conclusions are to be surfaced for public discussion and debate. The process is to be led from the Governor's Office, pending establishment of the Executive Office of Transportation and Construction, to insure decisiveness and adherence to the new policies.

Although the study plan covers an 18 month period, it is seen as the beginning of a new format for continuing, cooperative, comprehensive urban transportation planning.

II. Overview of the Planning and Decision Making Process.

The Study Design period (August-November, 1970) has been a testing and refinement period for the planning and decision making process outlined below. Its key characteristics are:

1. The process is participatory but decisive. Only through an open and broadly based participatory process can broad public consent or consensus for major decisions be obtained; but the role of this process should be to inform rather than supersede the regular governmental process. Decisiveness is facilitated by concentrating authority in the Governor. Deadlines will be set and adhered to.

2. It is multi-valued in orientation. As much attention

will be given to the by-products of transportation, and to its potential as a catalyst for community improvement, as to the transportation effects. All plans will be developed, and all decisions will be made, based on a balanced set of criteria representing the values of all concerned groups.

3. It is multi-modal. All facilities and services for intrametropolitan travel will be treated as part of a single system, each component to be planned in a manner most effectively utilizing its special characteristics in combination with other elements. Local service ("coverage") transit; bus rapid transit; new systems components and service concepts; operational and regulatory measures; and new terminal options will be included as well as the more conventional foci of transportation planning, major line haul highway and transit investments.

4. Equity requires full compensation to all who are affected negatively by transportation projects, taking due account of the impacts of other recent public works projects on the neighborhoods and families concerned. The Planning Review will endeavor to develop programs and designs that leave no one worse off in the wake of transportation projects than beforehand.

5. Decisions will be made on "program packages." The components of each program package will include a wide range of transportation elements (e.g., expressways, rapid transit, arterial improvements, parking policy, local circulation and feeder transit), and also a wide range of complementary elements designed to alleviate negative impacts and exploit opportunities to improve the quality of life in impacted communities (e.g., economic development, replacement housing, improved community facilities). The analysis of each program package will include detailed consideration of the administrative and legal mechanisms required for its implementation.

6. The process will be concerned with both short and long-term plans. The integration of short and long-term planning can infuse immediate decisions with concern for the full range of their unintended by-products and long-term implications. It can as well keep long range planning more attuned to considerations of political feasibility and responsive to changing community values.

7. Staged decision-making. A major consequence of the integration of short and long-term planning is the need to reach decisions on the implementation of some projects during the course of the Planning Review, rather than to leave all decisions to the end. Similarly, program package analyses will include

consideration of alternative strategies for staging implementation of the component elements (e.g., expressways, transit extensions, local street and parking improvements, replacement housing).

8. An iterative process. Articulation of alternatives will go through several cycles at various levels of generality, gradually reducing the number of alternatives under consideration and, where appropriate, recombining elements into new program package alternatives. The aim is to encourage the flexible exploitation of emerging study results and insights throughout the Planning Review to develop improved alternatives.

The Governor will assume responsibility for all important decisions within the jurisdiction of the executive branch. However, he encourages action at other levels through the cooperative, participatory mechanisms established for this planning process. He anticipates following, insofar as he is able, consensus recommendations of the Boston Transportation Planning Review participants. This commitment creates an incentive to reach agreement in order to substantially influence decisions. It also places a burden on private group, state, regional and municipal representatives to accurately represent the interests and positions of the people for whom they are speaking.

The planning and decision process also is designed to serve as a working prototype for future urban transportation planning in the Commonwealth, in accord with recent Federal directives and the model elaborated in the second report of the Governor's Task Force on Transportation (June 1970).

The study plan itself is a reflection and a result of the participatory planning process. It is the product of intensive involvement by representatives of the following:

. . . Governor Sargent and 9 local elected chief executives

. . . state and local public agencies

. . . private institutions and associations

. . . professionals from a broad range of disciplines

The organizational structure for developing this study plan consisted of two major committees -- the Steering Group and the Working Committee. The latter, in effect, was the executive committee of the former, and was created at the suggestion of the Steering Group to work intensively with the chairman and the consultant staff. All meetings were open.

Both groups were chaired by Alan Altshuler, whom Governor Sargent has designated to serve as Director of the Boston Transportation Planning Review -- working out of the Governor's Office and reporting directly to the Governor.

Neither the Steering Group nor the Working Committee decided anything by vote. Where they achieved consensus (most frequently, on the limits of a range), the chairman and consultant staff abided by it. Where disagreement persisted, the emphasis was on full discussion to inform the chairman's decision. It was agreed that, on major issues, appeals might be taken from the chairman's decision to the Governor.

This general structure, and these basic groundrules, are intended to characterize the whole Boston Transportation Planning Review, except that the Governor's role will largely be delegated to the Secretary of Transportation after that office comes into operation on April 30, 1971. An active effort will be made, however, to enlarge the Steering Group membership by attracting the participation of a still wider range of interests, most notably committees of the General Court, localities less obviously affected by the Boston Transportation Planning Review than those already involved, and private groups.

All activities of the Boston Transportation Planning Review will be structured to comply fully with Federal and State statutory and administrative requirements. The Steering Group and Working Committee will serve in an advisory capacity.

The process will be closely coordinated with the North Shore Planning Review (a parallel study of highway and transit options, including I-95, for communities on the north shore of the Boston region) and the Governor's Intercity Transportation Task Force (studying V/STOL, high speed ground transportation, jetport policy, etc.).

Special arrangements are being made to assure responsible, effective, informed participation by all vitally interested groups. In addition to the mechanism provided by the Steering Group and Working Committee, these special arrangements include:

1. Community liaison -- a program of briefings, workshops and public meetings, involving officials and private groups, designed to provide two-way information flow.

2. Technical assistance -- expert staff will be made available to private groups and municipalities, on the basis of need, to translate ideas into concrete proposals and to estimate impacts of alternatives on their interests.

3. The iterative process should increase the effectiveness of participation by permitting many alternatives to be examined in sketch plan form, decreasing the time required for each plan-making cycle, and permitting feedback from participants to shape reformulation of plans and designs in later phases.

The Governor's representative will serve as chairman of the Steering Group and Working Committee and as study manager. In the latter capacity he will, in close consultation with the Steering Group and Working Committee, direct the study staff in the conduct of all work including technical assistance. Staff may include consultants under contract and personnel assigned by agencies, municipalities or other qualified local organizations.

The study plan recognizes that legislative action may be required to implement recommendations. Representatives of the Joint Legislative Committee on Transportation will be encouraged to participate. Draft legislation will be developed in close consultation with appropriate elected officials and committees.

Since program packages are likely to require action by several units of government, implementation will be given special attention throughout and special efforts will be made to seek coordination with all appropriate key officials.

III. Work Program and Study Process.

Since formation of the Steering Group and Working Committee, a substantial start on the study has been made through an intensive effort by participants.

During August a consensus began to emerge on the general scope and outline of the study process. Numerous position papers and value statements prepared by participants were developed into a comprehensive set of criteria, which, after several rounds of drafting, debating and revising, have been included in Section IV. These are to be used to guide staff in designing and evaluating all alternative program packages.

Beginning in August and continuing throughout the Study Design period, intensive effort was devoted to definition of the alternatives to be studied. The current status of that effort is reported in Section V. These, like the criteria of Section IV, are subject to refinement and redefinition in early portions of the full study. Consensus has already been reached that considerably increased attention should be given to traffic operations

("TOPICS") improvements and local service ("coverage") transit in the core cities and towns.

The general methodology for the study evolved slowly throughout the study design phase. Experience in the conduct of the Steering Group and Working Committee business necessitated an evolution of the groundrules for participatory aspects which have been incorporated in this study design. The nature of the alternatives and the key issues to be addressed dictated the use of analytical methods which are capable of dealing both with questions of broad regional system efficiency and with highly localized issues of mobility, community impact and operation of individual elements of the transportation system. These requirements fit well with the desire to plan an iterative process to accommodate needs of the participatory process and the desire to stage decisions throughout the study period.

The definition of criteria and alternatives to be studied led directly to identification of most of the particular studies needed. Some Study Elements (or portions thereof) were called for by participants concerned with the feasibility of implementing program packages as intended, and others by participants who identified particular opportunities to improve local conditions or solve problems as part of possible program packages in a corridor. Drafts of Study Elements went through substantial revision as a result of participants' reviews.

A last phase in the development of the study design was the allocation of budget to Study Elements. After full discussion in which all viewpoints were aired, consensus emerged on most of the budget elements. The final budget was determined by Governor's Office decision, seeking insofar as possible to accommodate the various viewpoints expressed.

The participatory aspects of the study plan place special demands on the work program.

Study Element #2, described in Part Two, will provide technical assistance by professional study staff to municipalities and interested private groups to assist them in developing proposals, and in gauging the potential impact of proposals upon their values and interests. This technical assistance will be allocated on the basis of need to groups seeking it, and will be under the supervision of the Study Director, working in close consultation with the Steering Group and Working Committee.

Study Element #2 also provides for a series of workshops. Workshops will be held in communities which would be directly affected by proposed transportation projects and perhaps elsewhere

as the need is determined. Early workshops will be devoted to describing the process, developing minimum, maximum and desirable standards to guide the study, and developing initial sketch plans. As sketch plans are developed, workshops will be devoted to discussion of them. In later phases of the process involving more detailed plans, a similar sequence of workshops will be conducted. Effective communications will be important in this process.

Monthly progress reports of the study management will be circulated among all interested groups to keep them informed and to notify them of planned public meetings, hearings, workshops, or forthcoming decisions. Meetings to discuss work with study staff will be held at the request of interested groups to the extent feasible.

Most of the Study Elements described in Part Two will involve important communications and interaction with participants and interested groups, including conduct of special surveys, the use of local area committees and special advisory committees. Results of all design and technical evaluation work will be distributed for review.

Public meetings will be held at all critical points in the study process when important decisions are to be made. These will be well-publicized meetings, held at convenient locations and open to the general public.

Three study phases are planned, each a complete cycle of plan design, evaluation and selection. These are preceded by the Study Design phase, completed with the submission of this document, and the pre-contract phase, during which preparation for the full study will be accomplished.

This pre-contract phase will involve:

1. Further organizing by private interests and others to participate effectively in the study.

2. Introductory workshops to contact and involve all groups who wish to participate actively.

3. Additional work on refinement of criteria.

4. Initial development of minimum, maximum and desired standards for selected criteria, including goals for land development.

5. Initial efforts to develop design inputs by participants.

6. Refinement of alternatives.

7. The selection of contractors.

8. The allocation of technical assistance among participants for Phase I work.

9. Providing public information on the study.

10. Making any necessary adjustments in the framework for participation to accommodate representation of new interests.

11. Establishment of subcommittees and advisory committees to handle various Study Elements or sub-regional portions of the study.

Phase I of the actual study begins after obtaining all necessary approvals of the Study Design and the employment of major contractors for the work. It is a highly compressed four month period of sketch planning in which a large number of alternatives will be designed in highly preliminary form and subjected to similarly tentative evaluations. Alternatives will include those identified in Section V, with possible revisions made early in Phase I.

The pre-contract functions of refining criteria, developing minimum, maximum and desirable standards, developing design inputs by participants, and conducting workshops and public meetings will continue with the aid of full study staff.

At the end of this period, attempts will be made to reach consensus on implementation of components of alternative transportation systems; elimination of some alternative systems, locations, or designs from further consideration; and selection or modification of sketch plans for further study in Phase II.

Special methods and short-cut estimating techniques will be used to make possible the work planned for Phase I.

Phase II work is the major, more thorough period of designing and evaluating a more limited number of alternatives. Some functions can begin before Phase I ends in the third month. Thirteen months are scheduled for this Phase. All of the functions of Phase I are repeated in more depth. Greater effort will be made during the later part of this Phase to reach consensus on implementation of recommended transportation and transportation related programs, or decisions to carry projects forward into final design.

A final period, Phase III, lasting from the twelfth to the eighteenth month, is reserved for design and evaluation of compromise alternatives which may result from previous plan-making cycles. Many previous studies have had to go through this type of phase inadequately because time and resources for this negotiation and resolution process had not been budgeted. It can be critical to the reaching of consensus. Essentially the same functions are scheduled as for Phase II, except that refinement of criteria and standards is not expected to be required.

IV. Criteria.

The criteria to be used in the design and evaluation of the alternative program packages have been developed from a series of position papers and value statements prepared by the participating groups which have been fully discussed in Steering Group and Working Committee sessions.

The importance of the criteria, and the need for a comprehensive listing, as a method for making explicit the values of the participants, is emphasized in the introduction to a memorandum submitted by the municipalities:

> "We agree with the statement . . . that 'values' are manifested, in one way or another, in nearly every aspect of a transportation study. This memorandum is an attempt to make explicit our values as they appear, in particular in (the) design and evaluation criteria . . . Past transportation studies have often failed to allocate sufficient resources to conduct an adequate assessment of the socio-economic effects of proposed transportation facilities. We have a very strong interest in seeing that the current Restudy does not repeat this deficiency."

Although the comprehensive list of criteria reflects the concerns and values of participants, the list is not final. Other criteria may need to be added if new concerns arise or if the existing criteria do not adequately reflect the range of values to be assessed.

In the framework of the study, the emphasis will not be on assigning formal weights to the criteria, but rather on using them as input to the design of program packages and the subsequent evaluation of alternatives.

Early in the study process, staff work will concenrate on

defining, with the help of the Working Committee, the actual measures which will be applied to the criteria during the evaluation procedures. In addition, standards or levels of performance will be set for values that should not be violated, e.g., levels of air or noise pollution, or desirable values to serve as design objectives, e.g., land use goals.

It is recognized that the volume of information that will be produced on each alternative will be considerable,and a central responsibility of the study staff will be to develop procedures for synthesizing the material into comprehensible form.

The list of criteria includes diverse measures which include monetary values, quantitative non-monetary values, and qualitative assessments. Thus, it will not be possible to rely on a single overall criterion for evaluating and ranking alternatives. It is also recognized that the Working Committee is unlikely to be able to agree on relative weights to assign to the various criteria.

Accordingly the information will be synthesized and presented in a number of different formats, including, but not limited to:

1. A formal benefit cost evaluation, in which the differences among each pair of alternatives for which monetary values can be reasonably computed, will be presented.

2. Summary measures of evaluation by major category of type of impact. These measures will be partly monetary, partly ordinal ranking scales, and partly qualitative assessments.

3. Summary comparisons of impacts on all major categories of socio-economic groups affected by alternatives.

4. Visual portrayals of all designs at regional and corridor scales. Joint development designs and transportation facilities will be described by architectural sketches and preliminary designs.

The following table lists, in summary fashion, the preliminary range of criteria developed during the study design process. The right hand column of the table lists the Study Elements (summarized in Part Two) within which:

1. The work of developing the measures or standards for each criterion will be carried out.

2. The performance of each alternative program package will be described in relation to the complete list of criteria.

Figure IV.1

PRIMARY RELATIONSHIP OF CRITERIA TO STUDY ELEMENTS

Criteria	Study Element
1. ECONOMY	
A. Costs of Highway, Transit & Traffic Engineering Improvements	
(1) Property Costs	SE#12 Replacement Housing etc.; SE#13 Business Relocation etc.; SE#5 Joint Development; SE #10 Environmental Studies
(2) Construction Costs	SE#4 Transportation System Design
(3) Auxilliary Facilities	SE#5 Joint Development etc.
(4) Replacement Facilities	SE#5 Joint Development etc.; SE#12 Replacement Housing; SE#13 Business Relocation ; SE#10 Environmental Studies
(5) Moving Expenses	SE#12 Replacement Housing etc.; SE#13 Business Relocation
(6) Business Relocation	SE#13 Business Relocation & Employment
(7) Construction for Non-Relocated Property	SE#5 Joint Development etc.
(8) Loss of Value	SE#5 Joint Development; SE#10 Environmental Studies
(9) Change in Tax Base	SE#5 Joint Development; SE#13 Business Relocation etc.
(10) Cost of Compensation During Construction	SE#12 Replacement Housing etc.; SE#13 Business Relocation etc.
(11) Operating Costs of Cities and Towns	SE#5 Joint Development etc.
(12) Changes in Rent Levels	SE#12 Replacement Housing etc.; SE#13 Business Relocation
(13) Continuing Services	SE#5 Joint Development etc.; SE#11 Regional Economy
(14) Relocation Programs	SE#12 Replacement Housing etc.; SE#13 Business Relocation; SE #10 Environmental Studies
(15) a. Costs on Public Agencies b. Costs on Public Groups	SE#6 Land Use & Travel Forecasting
(16) Capital Costs for New Equipment	SE#4 Transportation System Design
(17) Capital Costs of Additional Private Vehicles	SE#4 Transportation System Design
(18) Aggregate Costs vs. Available Resources	SE#11 Regional Economy
B. Operating Costs	
(1) Net Change in Car/Truck Operating Costs	SE#6 Land Use & Travel Forecasting
(2) Net Change in Transit Operating Costs	SE#6 Land Use & Travel Forecasting
C. Total Costs	
(1) Net Change in Total Operating Costs	SE#4 Transportation System Design; SE#6 Land Use & Travel Forecasting
2. TRANSPORTATION SERVICE	
A. Net Change in Travel Times	SE#6 Land Use and Travel Forecasting
B. (1) Frequency of Service, etc. -- Peak Hour	SE#4 Transportation System Design
(2) Frequency of Service, etc. -- Non-Peak Hour	SE#4 Transportation System Design
C. Access to Employment, etc.	SE#6 Land Use & Travel Forecasting; SE#7 Special Mobility Studies
D. Reliability	SE#6 Land Use & Travel Forecasting; SE#7 Special Mobility Studies
E. Convenience, etc., to User	SE#4 Transportation System Design
F. Waiting Times, etc.	SE#6 Land Use & Travel Forecasting
G. Integration and Coordination	SE#4 Transportation System Design
H. Clarity and Informativeness	SE#4 Transportation System Design
I. Ease of Boarding	SE#4 Transportation System Design
J. Net Change in Travel Times to Non-Users	SE#5 Joint Development etc.; SE#4 Transportation System Design
K. Privacy	SE#4 Transportation System Design
L. Change in Travel Time During Construction	SE#11 Regional Economy; SE#6 Land Use & Travel
M. Service to Unmet Transportation Needs	SE#7 Special Mobility Studies
N. Ease and Convenience of Handling Packages	SE#4 Transportation System Design
O. Convenience for Goods Movement	SE#4 Transportation System Design
P. Effects on Local Street System	SE#4 Transportation System Design
3. SAFETY	
A. Changes in Injuries, etc.	SE#6 Land Use & Travel Forecasting
B. Property Damage	SE#6 Land Use & Travel Forecasting
C. Protection During Demolition	SE#5 Joint Development; SE#14 Neighborhood Cohesion
D. Safety During Construction	SE#5 Joint Development; SE#14 Neighborhood Cohesion
E. Convenience During Construction	SE#4 Transportation System Design; SE#5 Joint Development
F. Meteorological Effects on User Safety	SE#4 Transportation System Design
4. COMMUNITY QUALITY	
A. Noise Levels	SE #10 Environmental Studies
B. Air Pollution	SE #10 Environmental Studies
C. Visual, Psyschologial Barrier	SE #10 Environmental Studies
D. Neighborhood Disruption (1-4)**	SE #10 Environmental Studies
E. Social and Cultural Impacts (1-8)	SE#11 Regional Economy; SE#12 Replacement Housing; SE#13 Business Relocation; SE#14 Neighborhood Cohesion
F. Development Opportunities (1-3)	SE#5 Joint Development
G. Effect on Community Strength & Growth (1-3)	SE#5 Joint Development
H. Visual Characteristics (1-6)	SE#5 Joint Development; SE#10 Environmental & Conservation Studies
I. Effects on Natural Features (1-6)	SE#10 Environmental & Conservation Studies
5. ACCEPTIBILITY AND ADAPTABILITY	
A. Coordination	SE#4 Transportation System Design
B. Adaptability to Social/Environmental Programs	SE#5 Joint Development;SE#10 Environmental Studies
C. New Technology	SE#8 Technological Planning
D. Changing Travel Desires	SE#6 Land Use & Travel Forecasting
E. Future Options & Irreversible Change	SE#4 Transportation System Design; SE#7 Special Mobility Studies; SE#6 Land Use & Travel Forecasting
F. Feasibility of Implementation (1-3)	SE#9 Administrative & Legislative Studies
6. DISTRIBUTIONAL EFFECTS	
A. Effect on Selected Groups (1-6)	SE#10 Environmental Studies; SE#12 Replacement Housing; SE#11 Regional Economy
B. Land Use Distributional Effects (1-2)	SE#5 Joint Development; SE#6 Land Use & Travel Forecasting ;
7. SHORT AND LONG TERM EFFECTS ON THE REGIONAL ECONOMY	SE #10 Environmental Studies
A. Positive or Negative Impacts on Federal Aid Funds	SE#11 Regional Economy
B. Positive or Negative Impacts on Alternative Program Packages	SE#11 Regional Economy; SE#10 Environmental Studies

* This table identifies primary responsibility for the generation of data & the measurement of performance, etc. There will be many areas of overlap & a clear need for continuous coordination. A major coordination role will be performed in Study Element 5 - Joint Development & the Development of Alternative Program Packages.

** Numbers in parentheses indicate sub-criteria, omitted here for simplicity.

V. Alternatives.

The final selection and refinement of the alternative program packages for the first phase evaluation will be a primary task during the early months of the study.

During the study design process, a wide range of alternatives has been described and reviewed by the Working Committee and the Steering Group. Although this process has reduced the number of alternatives to be evaluated, it is recognized that during the study, new alternatives or fresh combinations of alternatives may be generated.

Each defined program package will contain a set of transportation impact elements whose implementation will be tied inextricably to the implementation of the transportation elements. These elements will be designed to:

1. Integrate the transportation facility with the needs of, and maintain the integrity of affected communities.

2. Ensure that the transportation proposals are consistent with comprehensive regional planning goals and with local objectives and development priorities.

3. Offset the negative impacts of transportation facilities.

4. Capitalize on realistic opportunities to attract private development of the type most desired from each affected community's perspective.

5. Take advantage of opportunities which may be provided by the introduction of transportation improvements to help solve pre-existing problems identified by the communities.

A minimum standard will be that transportation program funds will be expected to assume responsibility for elements in (3) above. An objective in the design of these program elements will be to seek maximum feasible assistance from transportation programs in all of the above types of actions. Elements may include the provision or improvement of social and community services as well as physical facilities. Specific elements to be included cannot be identified accurately until completion of the relevant study activities, although it is known that substantial housing and joint development efforts will be required for alternatives involving new expressways in high density areas.

Consistent with the establishment of minimum levels of service or performance for transportation components, minimum

standards will also be set for the design and implementation of transportation impact elements of program packages. For example, procedures will be established to insure that replacement or relocation facilities are in place before the demolition of existing property.

Some transportation elements are common to all the program packages. Each alternative includes highway improvement and transit improvements. Variations in the alternative program packages occur in their emphasis on particular goals, including both transportation service goals and the related consequences. For example, arterial improvements are of some priority in every program package alternative. Some arterial improvement programs may emphasize taking through traffic off residential streets, or providing special improvements for transit vehicles.

Transportation System Elements which will be described will include expressways, arterial streets, transit elements, "mode mixers" (transfer points), and operational improvements.

In addition special attention will be given, where appropriate, to the interface between metropolitan and inter-regional transportation systems, such as the airport and possible high speed ground links.

The preliminary proposals are grouped into three broad alternatives. The main features of each alternative are summarized below. It is important that they are not seen as auto vs. transit, but rather as mixtures of different elements emphasizing different design philosophies or "themes".

The "themes" of each alternative are at present described by combinations of a number of generalized goals, e.g., (a) provide mobility for core area non-drivers, (b) provide highway mobility for suburban to downtown links, (c) stress minimal disruption to core area communities, (d) provide suburban to downtown transit mobility, (e) stress design to alleviate damaging impacts, or (f) provide for lateral or circumferential highway mobility.

It is envisaged that certain proposals will be eliminated as the study progresses and at the same time expressway, arterial, and transit elements that are common to all networks can be identified, approved and released for design and construction.

Alternative A

This alternative stresses highway mobility, particularly improvements in radial travel, with full compensation for any dis-

ruption through sensitive design and through the transportation impact elements of this program package. Some stress is also put on transit improvements, although it is recognized that demand for transit may be less than in other alternatives. This alternative is the most detailed in its present description of transportation elements, since it draws heavily upon existing and committed projects.

This alternative involves the greatest expressway construction. The expressways are basically the system described in the Eastern Massachusetts Regional Planning Project Summary Report, "Recommended Highway and Transit Plan", 1968.

There are several variations within this alternative which are sub-options to the EMRPP Plan. It should be recognized that others may be generated during the study process. The presently defined range is as follows:

1. EMRPP network with no Harbor Crossing and subset alternative substituting the Western Corridor circumferential for the Inner Belt.

2. EMRPP network including the Harbor Crossing with the Western Corridor circumferential substituted for the Inner Belt.

3. EMRPP network with no Inner Belt or Western Corridor circumferential, and

   (a) a study for the termination of Route 2 at Dewey and Almay Circle (with particular attention to the effect on local arterials, especially Alewife Brook Parkway and Fresh Pond Parkway).

   (b) a study for an alternative bringing Route 2 into the vicinity of Sullivan Square and making a connection with I-93/I-695.

4. All network tests to include:

   (a) a subset study for the presence or absence of the South End By-pass.

   (b) a subset study for the effect of making the Third Harbor Crossing a toll or a free facility.

The transit elements of this alternative will be drawn from the current MBTA Master Plan, but sub-options for extensions will include:

1. Bus lanes or buses on freeways, or separate busways, including some emphasis on transfer facilities and integration of service.

2. Dual propulsion transit vehicles which can operate on both rails and highways; or other new types of systems.

3. A subset study of the impacts of continuation or discontinuation of the various commuter rail lines serving the Boston area, with consideration also of effects of possible improvements to those services.

In addition, all sub-options tested will include a subset study of coverage intensive transit service improvements for the inner areas of the region. Transit coverage is described more fully in Alternative B but includes considerations for improving the use of existing facilities and new service through either traditional or innovative systems.

Alternative B

This alternative stresses the prevention of disruption in dense inner city neighborhoods through the restriction of expressway construction and the provision of mobility by transit. The relative emphasis between suburban line haul extensions and inner area coverage intensive service can be varied as a set of sub-options. The provision of increased highway mobility through arterial improvements and traffic operation improvements for either radial or lateral mobility can also be varied within this alternative as another major sub-option.

No new expressways will be constructed, e.g., no Inner Belt, Southwest Expressway, Route 2 Extension, Third Harbor Tunnel or relocated I-95 North.

Sub-options for arterial improvements cover a wide range running from heavy emphasis on improving operational characteristics for transit vehicles to substantial improvements designed to aid auto commutation into the inner city.

This alternative implies, by the restriction of expressway construction in the inner city, a much greater emphasis on transit than the other alternatives. Thus, without competing expressways to provide access to the inner city and the downtown, greater demand might result for some or all of the transit extensions described under Alternative A.

An alternative or supplement to a fixed rail extension in any given corridor might be a commuter bus service utilizing

(a) an existing radial highway; (b) a specially constructed busway; or (c) a reserved lane on an existing expressway.

Improvement of the non-line-haul aspects of transit service has been established as a major goal of the study and will be of central emphasis in this alternative. In order to provide adequate, attractive service to a range of potential users, a high level of "frequency" and "coverage" are considered vital. Coverage is emphasized because of the interrelationship of transit service and land use. Urban sub-areas which are capable of supporting this kind of service have certain characteristics: high residential density; relatively close proximity to other activity centers; and low auto ownership rates. In some areas, low income is correlated with this pattern, in others the existence of a well-served transit corridor results in significant increases in land use density and property rents. In short, the patronage base for this improved service is not confined to the poor, the handicapped, and the elderly, but represents a potentially very broad cross-section of urban citizens.

A variety of mechanisms to provide the service will be investigated, including but not limited to:

1. A Guaranteed Service Concept -- where a variety of different modes would provide a specified level of service at a guaranteed price, employing fixed route services, and demand activated vehicles.

2. An Increased Community Accessibility Concept -- involving changes in the service to critical social services and activity centers through the operation of jitney-type local operations, multi-fare taxi rides, and so forth. Major public investment would still be channeled into improvements of bus operations on arterial streets through routed service into downtown and network connections stressed as critical for inner city service.

3. An Improved Feeder Concept -- which would rely chiefly on improving the operation of existing bus service by modifications to the fare schedules, improving transfer facilities, utilizing new equipment, and so forth.

4. Feeder to Line-Haul Concept -- which would concentrate on developing bus services as a feeder to the proposed line-haul transit improvements.

Alternative C

This alternative stresses the provision of both highway mobility and transit mobility. Sub-options in regard to transit

mobility range from relatively heavy emphasis on suburban to downtown commuter service, to a heavy emphasis on the kind of improvement in inner city service described in Alternative B. The major point is that some expressways may be reduced in scale from the EMRPP system and the expressway system may not include all the links within the EMRPP system.

This alternative contemplates an intermediate level of expressway construction between A and B. In some or all cases, the scale of the proposed highways might be reduced from eight to six or even four lanes. Both full and partial networks will be defined and tested.

1. Network to include all EMRPP links, but some or all of them at a reduced scale, e.g., reduced scale Inner Belt, Southwest Expressway, I-95 relocated through East Boston, and Route 2 extension.

2. Reduced scale EMRPP network with the Western Corridor circumferential substituted for the Inner Belt. The possibility of merging the Western Corridor circumferential into the Massachusetts Turnpike extension at Brighton and converting the remainder of the Turnpike into a free road through refinancing would be a subset study.

3. A set of networks with reduced scale links and interface with the transit system, e.g.,

   (a) A reduced scale Southwest Expressway might run from Route 128 to Forest Hills with a mode mixer (e.g., "park-and-ride") to provide efficient transfers to transit for downtown traffic.

   (b) Route 2 to terminate at the end of the proposed MBTA Extension from Harvard Square to Alewife Brook.

4. A reduced scale inner city distribution system utilizing the Boston portion of the Inner Belt and either the Western Corridor circumferential or the Cambridge Inner Belt, but with no more radial expressway connections, e.g., no Route 2, no Southwest Expressway, no I-95/Harbor Tunnel.

The relative emphasis between transit extensions and coverage-intensive service is a sub-option as in other alternatives.

The same transit extension sub-options listed in Alternative A exist in C. The same transit coverage and transit extension sub-options listed in Alternative B also exist in C.

VI. Study Elements

All work of the study is covered by 14 Study Elements organized by categories of work to be performed.

It should be emphasized that these elements form an integrated whole and should not be thought of as tasks which can be performed separately by organizations working in isolation from one another.

The summary budget recommended for the 18 month study period is shown on the attached table. Estimated costs of the study are shown (in the first three columns) by Study Element, for each of the three study phases. In addition to these costs, ranges of costs are shown for each Study Element for the later two phases (second-to-last column). The total cost of each phase of the study is shown in the bottom rows of the table: Phase I--$839,000; Phase II--$1,902,000 (range $1,700,000 to $2,100,000); Phase III--$759,000 ($550,000 to $950,000). Total cost of the study is estimated at $3,500,000.

The reason for showing ranges of costs for later phases is that the precise scope of that work must depend on results of early work -- decisions on selection and elimination of alternatives, the specific nature of program packages being designed, and the relative emphasis that needs to be placed on various criteria in order to facilitate decisions and address concerns responsively.

Descriptions of each of the Study Elements follows:

General Study Elements -- Those Study Elements dealing primarily with study management, mechanisms for participation, and the general process for evaluating alternatives, rather than with specific technical aspects of design, evaluation and implementation of alternatives.

1. Study Management -- to provide immediate staff for the Steering Group and Working Committee, to provide the major creative effort in formulation of alternative program packages in response to values and priorities of participants, to oversee and coordinate the work of all other staff performing other Study Elements, and to handle arrangements for all public meetings, workshops and major communications.

2. Community Liaison and Technical Assistance -- to provide adequate communication and interaction mechanisms for the continuance of the participatory planning process throughout the study; and to provide substantive technical assistance to those participants who lack sufficient resources to play an effective part in the study.

3. Use of Design and Evaluation Criteria -- to refine the criteria used for design and evaluation in each study phase; to develop minimum and desirable standards for selected criteria, including land development goals; and to synthesize all evaluation measures in the form of overall benefit-cost comparisons and other summary comparisons to assist the Steering Group, Working Committee and other participants in performing their evaluations and arriving at recommendations for implementation.

Transportation Elements -- Those Study Elements dealing primarily with the design and evaluation of transportation components and systems and the joint development work necessary to integrate other facilities and services with transportation components.

4. Transportation System Design -- to design each of the transportation system components (expressways, arterials, rapid transit lines, terminals, local service coverage transit system improvements, various operational and TOPICS-type improvements), in coordination with all other study elements involved in the design work, and to provide information on those criteria dealing with transportation service and costs.

5. Joint Development and the Development of Alternative Program Packages -- to identify and relate transportation impact components of the alternatives, to integrate them with the Transportation System Design elements, and to design the total program packages in appropriate detail for evaluation.

6. Land Use and Travel Forecasting -- to forecast the effects of the alternative transportation systems on regional patterns of land use and intensity of development; to forecast travel on all parts of the system, taking into account competition among modes, effects of congestion, fares, tolls and parking fees; to provide information on the achievement of those criteria dealing with operating costs, service levels and land development goals; and to provide information on transportation user effects by type of group.

7. Special Mobility Studies -- to assess needs and develop recommendations to meet previously unmet or latent transport needs, with particular reference to especially disadvantaged groups, e.g., autoless households, the unemployed, the disabled, the elderly, and those too young to drive.

8. Technological Planning -- to identify those near-term innovations of high potential benefit to the Boston area for incorporation in the transportation system alternatives, and to provide information on longer term innovations which should be planned for, so that current system designs can accommodate them readily when they become available.

Implementation Element

9. Administrative and Legislative Studies -- to address the problems of implementation of program packages and the framework for continuing transportation planning, under the following functional headings:

   (a) Administrative cooperation and delivery systems.

   (b) Feasibility of implementation of alternative program packages.

   (c) The participatory process and the restudy.

   (d) An analysis of existing and proposed State & Federal regulations and legislation.

Transportation Impact Elements -- Study Elements dealing primarily with transportation impacts and the design and evaluation of aspects and components of alternative program packages which are complementary to transportation components.

10. Environmental and Conservation Studies -- to assess the impact of alternative program packages on ambient noise levels, air pollution, visual intrusions, and the positive and negative effects on natural features, eco-systems, open space, park plans, and symbolic and historical assets; and to integrate this impact information into the process of evaluating alternatives and in the process of locating and designing transportation facilities.

11. Effects of Alternatives on Regional Economy -- to assess the absolute and relative impacts that the alternatives can be expected to have on:

   (a) The costs, growth and effectiveness of operation of long-haul goods movement, including containerization.

   (b) The gross regional economy and its sectors.

   (c) The costs of doing business, producing goods and providing services.

(d) The ability of the region to compete with other regions in retaining and attracting firms or encouraging expansion within the region.

(e) Attracting tourists to the region.

(f) Affecting the size of Boston's economic hinterland and therefore the size of distributive industries and the volume of interregional trade.

12. Replacement Housing and Family Relocation -- to provide specific data on the number, type and special characteristics of families who would be relocated under each of the alternative program packages to be evaluated; to use this impact information in the evaluation of alternatives and in the design and redesign of alternatives; and to develop a replacement housing and relocation program as part of the recommended program packages.

13. Business Relocation and Employment -- to develop specific data on the number, type and special characteristics of business which might require relocation under each of the alternative program packages to be evaluated; to examine current procedures, agency responsibilities and legal requirements; to develop a replacement and relocation program for displaced businesses; to evaluate the comparative effects of alternative transportation systems in attracting needed job opportunities; and to use this information to aid in the transportation system design process.

14. Neighborhood Cohesion and Transportation Needs -- to identify and measure the degree of social interaction and neighborhood cohesion and the importance of neighborhood identity; to assess special local transportation problems, opportunities and needs; to assess the importance of existing and potential internal and external linkages; to analyze disruption problems which have occurred in the past during right-of-way acquisition, demolition and construction; to use this information to aid in the transportation system design process and in developing improved means for alleviating recognized problems; and to analyze, measure and evaluate the extent to which alternative program packages disrupt neighborhoods by severing or hindering linkages, inducing through traffic, etc. or the extent to which they improve cohesion and alleviate existing problems.

VII. Budget Summary by Study Element and Phase

A budget summary for all Study Elements follows.

Budget Summary by Study Element and by Phase

Showing Ranges of Cost Desired for Flexibility in Later Phases

Study Elements	COSTS BY PHASE (000's) I	II	III	Totals	Estimated Ranges II &III	Total
General Study Elements	$154	$387	$169	$710		
1. Study Management	60	170	100	330	$240-300	$300-360
2. Community Liaison & Technical Assistance	80	205	65	350	245-295	325-375
3. Use of Design & Evaluation Criteria	14	12	4	30	10-25	25-40
Transportation Elements	$495	$1170	$410	$2075		
4. Transportation System Design	170	505	85	760	430-790	600-960
5. Joint Development & the Development of Alternative Program Packages	70	280	150	500	380-630	450-700
6. Land Use & Travel Forecasting	215	325	160	700	485-700	700-915
7. Special Mobility Studies	28	43	4	75	30-90	60-120
8. Technological Planning	12	17	11	40	20-45	30-55
Implementation Element	$20	$35	$25	$80		
9. Administrative & Legislative Studies	20	35	25	80	45-85	65-105
Transportation Impact Elements	$170	$310	$155	$635		
10. Environmental & Conservation Studies	35	75	40	150	95-135	130-170
11. Effects of Alternatives on Regional Economy	20	40	20	80	50-70	70-90
12. Replacement Housing & Family Relocation	65	115	55	235	130-230	195-295
13. Business Relocation & Employment	40	60	30	130	70-150	110-190
14. Neighborhood Cohesion & Transportation Needs	10	20	10	40	20-40	30-50
TOTALS	$839	$1902	$759	$3500		
Range		$1700-2100	$550-950	$3100-3900		

PART ONE

GENERAL STUDY DESIGN

SECTION I

STUDY PLAN FOR A

BALANCED TRANSPORTATION DEVELOPMENT PROGRAM

This Study Plan is a response to the challenge and opportunity identified by Governor Sargent in several policy statements this year. To quote the Governor's Task Force on Transportation:

> "The Boston region is at a crossroads in transportation policy. Critical investment choices have to be made in the near future. Dissatisfaction with the existing transportation decision process, and with its products, is rife. And there is a widespread willingness to consider fundamental changes in the organization and philosophy of transportation decision making.
>
> "This willingness to consider fundamental change has been shaped by two major crises: on the one hand, the fiscal crisis of public transportation; on the other, growing resistance to the deleterious by-products of private transportation--most notably, those of the new urban expressways that have been planned to accommodate the private car.
>
> "Both crises have reached a new peak of intensity at a time when fundamental reorganization of the state government is already under way. In April 1971, nearly all state agencies are to be brought within ten Executive Offices, all headed by gubernatorial appointees who will collectively constitute a Governor's Cabinet. One of these new offices will be the Executive Office of Transportation and Construction. Its Secretary will have an opportunity for multi-modal policy leadership that no state official has ever had previously.
>
> "...If (this opportunity) is exploited effectively, we believe the current transportation crises will be viewed in future years as having laid the groundwork for an era of great and genuine transportation progress." 1/

1/ Governor's Task Force on Transportation, "Report to Governor Sargent, Part II," June 1970, p. 1.

The study plan which follows has been designed fully to exploit this opportunity.

The cities and towns in the eastern portion of the Commonwealth of Massachusetts fully recognize that of the many threads which make up the fabric of their complex urban society, the transportation thread is among the most important.

In recent years, the diverse elements and interests of our urban society have become more aware and more knowledgeable of the influences, both desirable and undesirable, that transportation has on the social, economic, political and environmental threads of our societal fabric. This awareness and its accompanying concern has been expressed in many ways, including statutory policy enacted by the Congress and by the legislature of the Commonwealth. It has been expressed in policy statements by the Secretary of the U. S. Department of Transportation and by the Governor of the Commonwealth. It has been echoed and re-echoed by city and town officials, by our communications media, and by many organized private groups.

The desirability of using the transportation thread to shape and mold the urban fabric is at the heart of the Study Plan contained in this document. The objective is to use transportation decisions and other closely related actions to preserve and enhance the natural and man-made environment; to improve the quality, vitality and integrity of neighborhoods; to retain and increase needed jobs in inner city areas; to reverse the deteriorating housing market conditions of older communities which have been impacted by previous transportation decisions; to improve the mobility of all citizens; and to speed the flow of goods so necessary to the metropolitan economy.

The Study Plan builds upon the significant advances which have been made in past transportation planning activities in the Boston metropolitan area, and fully recognizes both the letter and the spirit of dynamic new policies and programs which offer the opportunity to bring about more comprehensive urban transportation planning.

Transportation plans for the Boston metropolitan area, particularly within Route 128, have a long history. A summary review of how these transportation plans were developed and adjusted over the years, and the setting in which these activities took place, is essential to an understanding of the Study Plan set forth in this document.

Recent Transportation Planning History

Modern transportation planning in the Boston metropolitan area has its base in the years immediately after World War II, just as it has in almost every major urban area in the nation. With the increase in ownership and use of automobiles after the war, high priority was placed on the planning and development of highway facilities to accommodate the rapid expansion of private transportation.

The Massachusetts Department of Public Works responded to this priority public policy assignment with its Master Highway Plan of 1948,2/ a plan which has been partially implemented and which remains the basic highway plan for the region. Similar plans were produced in major metropolitan areas throughout the nation in the late 1940's and early 1950's.

The Federal Government, through its Bureau of Public Roads, with the cooperation of state highway agencies in each of the states, also developed a national intercity network plan, the original version of which was published as the Interregional Highway Report of 1944. 3/

Revised versions of the national plan and the combination of urban area plans became the basis for the enactment of legislation by Congress in 1954 and 1956 to create a 41,000-mile urban and rural Interstate and Defense Highway System. 4/

2/ Joint Board for the Metropolitan Master Highway Plan, Master Highway Plan for the Boston Metropolitan Area, (based on a Traffic Survey by the Department of Public Works), prepared by Charles A. Maguire and Associates with De Leuw, Cather and Company and J. E. Greiner Company, February 1, 1948.

3/ U. S. Department of Commerce, Bureau of Public Roads, Interregional Highway Report of 1944, (as submitted to U. S. Congress.)

4/ Federal Aid Highway Act of 1954, May 6, 1954; Federal Aid Highway Act of 1956, June 29, 1956; (see Title 23, U.S.C., Sec. 104 (d)).

The enactment of the Interstate and Defense Highway System program had these primary effects:

1. The Boston metropolitan area's portion of the Interstate System was designated by specific corridors and with stringent mileage limitations.

2. Federal financial assistance for Interstate System expressways was so great that consideration of other potential priorities was severely discouraged.

3. Great incentive was placed on planning for as much capacity and traffic service as possible on Interstate System routes, since providing capacity and service on other new routes or rebuilding old ones would have to be accomplished with a maximum of 50-50 Federal funding, or entirely with Commonwealth funds.

4. The design standards adopted for Interstate expressways were such that vast land taking was required, the use of existing highway rights-of-way was essentially precluded, substantial disruption was made inevitable, and longer distance through-movement was given priority by standards established on interchange spacing.

5. No provision was made in the Interstate program for alleviating effects on elements of the road system other than the new freeways and interchanges, particularly effects upon connecting local roads and streets, and parking.

6. No funds were made available for paying directly or indirectly (except owners of property within the right-of-way) for the major economic, social and environmental disruption which accompanied Interstate System expressway construction. The magnitude of these disruptive consequences substantially increased in areas of denser urban development, and thus the greatest controversies arose in the densest urban areas.

Although transit improvement plans were proposed during the post-World War II period, highway planning and development with assured funding continued for a full decade before any similar commitments to public transportation improvements were made. The radical decrease in ridership and deterioration of service were prevalent for several years before a crisis loomed. In quick succession, the Old Colony Area Transportation Commission was established in 1958, the Mass Transportation Commission in 1959, a Special Legislative Recess Commission in 1959, and the South Shore Transportation District in 1961.

The study efforts of these groups led to the reorganization of the old Metropolitan Transit Authority into the present Massachusetts Bay Transportation Authority in 1964, and the first significant effort to rebuild the public transportation system was started.

The Department of Public Works, meanwhile, had undertaken a sizable re-analysis of the expressway system in 1962 and openly sought greater coordination with public transportation plans. Its report of that year said:

> "Every effort should be made, by responsible agencies, for integration of present and contemplated studies of mass transportation with the recommendations of this study."5/

The DPW's 1962 study also undertook for the first time a detailed systematic study of the social and economic effects of the expressway system. Although the report concluded that there would be substantial overall benefits to the region, it acknowledged that some hardships would occur.

The public and private institutions of the Boston metropolitan area were among the leaders in seeking Federal assistance in the early 1960's to build and rebuild public transportation systems. The first assistance was made available under the Housing Act of 1961,6/ but no significant funds were provided for capital improvements until the Urban Mass Transportation Act of 1964.7/ Not until 1970 did Congress pass legislation providing long term, large scale financing for public transportation improvements.8/

5/ Massachusetts Department of Public Works (DPW), Inner Belt and Expressway System--Boston Metropolitan Area, 1962, p. I-2.

6/ Housing Act of 1961, Public Law 87-70, June 30, 1961

7/ Urban Mass Transportation Act of 1964, Sections 3 & 4, pp. 2 & 3.

8/ Urban Mass Transportation Assistance Act of 1970, Public Law 91-453, October 15, 1970.

On balance, from the end of World War II until the present, the Transportation policy of the Federal Government and the Commonwealth has been overwhelmingly oriented toward the construction of intercity and urban area expressways.

The deleterious consequences of this heavily one-sided policy have gradually been recognized by Federal, State and local officials and by private groups throughout the nation and the metropolitan area. Concern over these consequences has led to many changes in public policy, including:

. . . A continuing comprehensive transportation planning process to coordinate private and public transportation, and to give due consideration to the effect of transportation on future development, was made mandatory by the Federal Highway Act of 1962.9/

. . . Hardships caused by the displacement of families and businesses were officially recognized by the same Act, which for the first time required that state highway agencies provide advisory relocation assistance. 10/

. . . The first significant step to stop and reverse the deterioration of public transportation was accomplished with passage of the Urban Mass Transportation Act of 1964.

. . . A Bureau of Transportation Planning and Development in the Department of Public Works was created by the Massachusetts General Court in 1964. It was mandated to carry on continuous comprehensive transportation planning and to coordinate transportation plans and programs with comprehensive urban development plans.11/

9/ Federal-Aid Highway Act of 1962, Public Law 87-866, October 23, 1962, Sec. 9 (a), (see Title 23, U.S.C., Sec.134).

10/ Ibid., Sec. 5 (a), (see Title 23, U.S.C., Sec. 133).

11/ Chapter 563, Section 1, Acts of 1964, amending Chapter 16 of the General Laws of the Commonwealth by adding a new Section 3A.

. . . The U. S. Department of Transportation was created in 1966. Its enabling statute directed it to facilitate the development and improvement of coordinated transportation service.12/

. . . Federal policy recognition of the impact transportation programs were having on parts of the natural environment came in 1966, in the form of stringent requirements to avoid certain types of public lands if prudent and feasible alternatives existed, and to permit the use of such lands only if all possible planning to minimize harm was undertaken.13/

. . . Advisory relocation assistance was recognized as an inadequate mechanism of overcoming dislocation hardships in the Federal Highway Act of 1968. A system of generous relocation payments was established so that a few individuals would not suffer disproportionate injuries as a result of programs designed for the benefit of the public as a whole.14/

. . . The lack of attention previously accorded the importance of existing streets and highways was recognized by the Federal Highway Act of 1968, and funds were authorized for TOPICS programs and projects.15/

. . . The potential of intermodal transportation service also was recognized in 1968, when Congress authorized the use of highway funds for construction of fringe area parking to facilitate convenient transfer between private and public transportation.16/

12/ Department of Transportation Act, Public Law 89-670, October 15, 1966, Sec. 2 (b)(1).

13/ Federal-Aid Highway Act of 1966, Public Law 89-574, September 13, 1966, Sec. 15 (a), (see Title 23, U.S.C., Sec. 138.)

14/ Federal-Aid Highway Act of 1968, Public Law 90-495, August 23, 1968, Sec. 30 (see Title 23, U.S.C., Sec.501).

15/ Ibid., Sec. 10 (see Title 23, U.S.C., Sec. 135). ("TOPICS" stands for Traffic Operations Program to Improve Capacity and Safety.)

16/ Ibid., Sec. 11

. . . The importance of public participation in transportation planning was recognized in 1968, when the Federal requirements for public hearings were substantially elaborated.17/

. . . In 1968, Federal law also made it mandatory to give consideration to the economic and social effects of highways, their impact on the environment, and their consistency with the goals and objectives of local government plans. For the first time, social, economic and environmental effects were defined as direct and indirect benefits and losses to both the community and highway users.18/

. . . High priority was placed upon the critical importance of restoring and maintaining environmental quality through the National Environmental Policy Act of 1969, which stated that it is the continuing policy of the Federal Government, in cooperation with State and local governments and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and to fulfill the social, economic and other requirements of present and future generations of Americans.19/

. . . Institutional barriers among agencies and programs in the Commonwealth also were recognized with the creation of a Secretary of Transportation and Construction who, starting in 1971, will have responsibility for coordinating the activities of most state agencies with transportation responsibilities, and for devising a more integrated institutional framework for the Commonwealth's transportation activities.20/

17/ Ibid., Sec. 24 (see Title 23, U.S.C., Sec. 128).

18/ Ibid., (see Title 23, U.S.C., Sec. 128 (a))

19/ National Environmental Policy Act of 1969, Public Law 91-190, Sec. 101 (a)

20/ Chapter 704, Acts of 1969, An Act Establishing a Governor's Cabinet, amending Chapter 6 of the General Laws by adding Section 17A, and adding Chapter 6A, including Section 19 dealing with Transportation and Construction.

The Federal Government, in addition to the explicit policy and program changes requested by the executive branch and enacted into law by the Congress, also has mandated substantial changes in transportation planning and development through Administrative policy.

The concept of joint development of transportation projects with other types of development, redevelopment or improvement to overcome social, economic and environmental impacts has been instituted, particularly in connection with the Federal-aid highway program; and highway funds have been made available for planning and implementation within statutory constraints.21/

Use of the Federal-aid Highway Program to promote the advancement of bus public transportation has evolved into a major administrative policy, and several demonstration projects have been undertaken with considerable success.

At the state level the Massachusetts Department of Public Works, in cooperation with the Massachusetts Bay Transportation Authority, the Metropolitan Area Planning Council and the Department of Commerce and Development, created, carried out and completed in 1968 the Eastern Massachusetts Regional Planning Project (EMRPP).

The EMRPP was the most extensive and comprehensive transportation planning project ever carried out in the Commonwealth. It clearly led the nation with some of its planning techniques, such as the development of a mathematical model, EMPIRIC, to more flexibly and reliably relate land use projections to transportation requirements and traffic assignments.22/

The EMRPP also closely integrated highway and public transportation planning for the first time, an achievement which had not been practicable in previous studies, particularly before the formation of the MBTA.

21/ U. S. Department of Transportation, Federal Highway Administration Policy and Procedure Memorandum 21-19, January 17, 1969.

22/ Eastern Massachusetts Regional Planning Project, Recommended Highway and Transit Plan, p. 26.

The EMRPP explicitly and implicitly recognized the drastic and fundamental changes which had occurred in the 1950's and 1960's in the metropolitan area. It recognized the many changes in policies at the Federal, State and local levels of government. It also recognized the emerging changes in public attitude, the importance of social, economic and environmental impacts, and the necessity of treating transportation as a total, balanced system.

These recognitions were manifested most clearly in EMRPP's comprehensive set of goals, objectives and policies. The extensive set of policies included a set of environmental and conservation statements dealing with open space, recreational areas, community disruption and relocation assistance, noise, pollution, preservation of unique natural and historical areas, and conservation and modernization of older industrial and commercial areas. Transportation policies included statements dealing with job access, joint development, equitable Federal participation in all modes, priority to traffic operations improvements in the short term, and encouragement of transit use to downtown through a variety of measures including parking rate structures, improved transfer facilities, improvement of bus and auto access to rapid transit terminals and special priorities for rapid bus movement.

The policies cited above are not to be considered more or less important than the full set of goals, objectives and policies set forth in the EMRPP Report on the Recommended Highway and Transit Plan.23/ They are cited, however, to demonstrate that the Department of Public Works, the Massachusetts Bay Transportation Authority, the Metropolitan Area Planning Council, and the Department of Commerce and Development cooperatively have established a comprehensive framework of goals, objectives and policies which responds to policies enacted over the past several years by the Congress and is fully consistent with (in some cases identical to) the administrative policies of the U. S. Department of Transportation.

However, there are a number of shortcomings in previous planning when viewed from today's perspective.

The EMRPP accepted as committed the previous plans of the DPW and the MBTA, which consisted of the 1948 Master Highway Plan, as modified in 1962, and the MBTA plan of 1966, which had its origins in the 1959 to 1962 period.

23/ Ibid., pp. 14-18.

Thus, the highway plan developed immediately after World War II, and the Transit Plan developed with primary emphasis on continuation and extension of suburban service, was carried forward into the 1970's.

All alternatives tested in the EMRPP contained the same designated Interstate highway system without variation in size or other features. Since that time a number of questions and controversies regarding the environmental and social impacts of these older designs have been raised. A serious housing crisis has developed. Loss of inner city jobs has created critical unemployment problems. Tax losses, noise, air pollution and traffic in neighborhoods have all become major concerns of core area communities.

Many potentially promising new approaches in transportation planning have developed, including joint development, bus rapid transit, and mechanisms for improving the efficiency of operation of both arterials and expressways.

Changing patterns of regional development and better understanding of the character and functions of the regional core vis-a-vis the transportation system have led to a need to reexamine certain features of the expressway system, such as number of lanes warranted, modal transfer facilities and interchange configuration.

The Boston area's core, as much or more so than the core of other dense old cities, is characterized by narrow streets, short blocks, and high intensity of building coverage resulting in serious limitations on the capacity that can be provided for parking and surface traffic. During the last few years there has been a growing recognition that expressway planning will only intensify the problems caused by these conditions unless it fully incorporates planning for local traffic movement and parking supply.

Since the adoption of the EMRPP plan, unexpectedly high costs of construction and operation have plagued MBTA and caused increasing deficits.

Substantial improvements in local coverage transit service within densely built up core communities were not studied in the EMRPP.

These factors and the reactions within the region, together with greater understanding of the role and potential of public transit, are cause for reevaluation of previous MBTA plans.

Most of the major changes in Federal and State policy cited previously have also occurred since the time that the original plans were developed.

Public attitudes have changed fundamentally in parallel with the cited public policy changes, and in fact the latter are a reflection of the former. Concern over the environment, employment, taxes, housing, social disruption, mobility for all citizens and other issues cited above has become particularly intensive and closely related to transportation decisions in the Boston area.

In response to these changes in public attitudes, public policy, and the other factors discussed above, the Governor appointed a Task Force in October 1969 to begin a fundamental reexamination of the Commonwealth's transportation plans and policies. It submitted two reports to him--one in January 1970 and a second in June 1970.24/

Among its many recommendations, the Task Force wrote as follows:

> "We urge you to initiate a new process, and a new era, in Boston transportation planning--one in which a genuine integration of social, environmental, economic, and transportation criteria will be sought; one in which assumptions, options, and conclusions will be surfaced for public discussion, debate, and decision.
>
> "This process should be led from your office, pending establishment of the Executive Office of Transportation and Construction. The comprehensive planning process should be viewed as an incremental and continuing one, charged with adapting transportation programs to changing needs, resources, and social values as they emerge.
>
> "The initial planning review, in our judgment, should focus on a broad range of transportation options, including:
>
> (a) development options for the Southwest corridor;
>
> (b) development options for radial transportation through Cambridge, including the proposed Route 2 highway extension and Harvard-Alewife transit extension;
>
> (c) alternatives of location and scale for the Inner Belt through Cambridge, including the so-called 'Western Corridor'...

24/ Governor's Task Force on Transportation, "Report to Governor Sargent on Immediate Action Opportunities," January 1970; "Report. . ., Part II," June 1970

(d) various proposed means of improving integration of the private automobile and public transportation systems, with particular attention to interface points;

(e) the full range of expressway, 'mini-expressway,' arterial, local street, and parking investment options within Route 128;

(f) the full range of public transportation options, including express buses, rail transit, smaller vehicles, and 'people movers;'

(g) facility management investment options within Route 128."25/

The Governor, acting on the Task Force's first recommendation, announced on February 11, 1970, that he was making major changes in the Commonwealth's Transportation Policy.26/

The Governor suspended design work and land acquisition on certain highway segments within Route 128. He stated explicitly that a reexamination of the Commonwealth's transportation plans for the region within Route 128 was required in the light of changing Federal policies and societal values.

The scope of the planning review was expanded in September 1970 when the Governor announced his decision to include the proposed Third Harbor Tunnel and its expressway connections in this study.27/

Governor Sargent called for a new planning process aimed at developing a balanced transportation development program--a process which would plan for the future based upon recently established and newly emerging policies of both the Commonwealth and the Federal Government.

25/ "Report to Governor Sargent on Immediate Action Opportunities," p. 7.

26/ "Press Release," Governor's Press Office, State House, Boston, February 1, 1970. See Appendix for full text.

27/ "Press Release," Governor's Press Office, State House, Boston, September 1, 1970

The study plan contained in this document is the start of that new direction towards a Balanced Transportation Development Program, a program which the Commonwealth seeks in partnership with the Federal Government.

The principal characteristics of the new planning process are described in the next Section.

SECTION II

OVERVIEW OF THE PLANNING AND DECISION MAKING PROCESS

The development of the study plan contained in this document has been a prelude to and a demonstration of the planning and decision-making process which is to take place during the course of the study subsequently described.

The planning and decision making process has the following primary characteristics:

1. The process is participatory but decisive. The aim is to demonstrate that participatory planning can produce results. It recognizes that only through an open and broadly based participatory process where the full spectrum of values, priorities, ideas and proposals from all interested parties have assurance of full and fair consideration can this process secure broad public consent or consensus for major decisions. The participatory aspect should infuse the entire process by which options are conceived and analyzed. But its role should be to inform rather than supersede the regular governmental process. Decisiveness is facilitated by concentrating authority in the Governor and, beginning next spring, his Secretary of Transportation. Put another way, the process will involve a sustained dialogue among the widest possible range of interested parties; but it will be deadline and action oriented.

2. It is multi-valued in orientation. That is, it will give as much consideration to the by-products of transportation investment alternatives as to their intended transportation effects. These by-products will include, but not be limited to the following:

. . . effects on the supply of low and moderate income housing;

. . . effects on the supply of recreational open space;

. . . air and noise pollution impacts;

. . . land-use development impacts;

. . . effects on such social values as racial integration and neighborhood stability;

. . . local tax base and employment impacts;

. . . effects on the visual attractiveness and overall congeniality of the urban environment.

The emphasis will not be on assigning dollar values to all identifiable costs and benefits. It will rather be on: (a) describing the likely consequences of each policy option as precisely as possible, whether or not they can be quantified; (b) conducting sensitivity analyses to help evaluate the significance of risks and uncertainties, and (c) designing from the start to achieve an optimal reconciliation of the main values identified -- rather than designing initially with narrow values in mind, and then seeking to accommodate other important societal values by "tinkering" at the margins.

3. It is multi-modal. The planning and financing of all facilities and services intended primarily to accommodate intra-metropolitan travel are included. The various modes and elements of the transportation system will be treated as part of a single system rather than separate networks. Thus, efforts will be made to utilize each element in a manner which most effectively utilizes its special characteristics in combination with other system elements.

Elements included are local and arterial street improvements as well as expressways; local service or "coverage" transit as well as rapid transit; bus as well as rail rapid transit; new systems, new components and new service concepts as well as conventional modes; operational and regulatory measures as well as capital-intensive system additions; and parking, transit terminals, and major facilities for encouraging auto-transit transfer ("mode-mixers") as well as facilities for line haul movement.

4. Equity requires full compensation to all who are affected negatively by transportation projects, taking due account of the impacts of other recent public works projects on the neighborhoods and families concerned. The Planning Review will endeavor to develop programs and designs that leave no one worse off in the wake of transportation projects than beforehand.

5. Decisions will be made on "program packages". The components of each program package will include a wide range of transportation elements (e.g., expressways, rapid transit, arterial improvements, parking policy, local circulation and feeder transit), and also a wide range of complementary elements

designed to alleviate negative impacts and exploit opportunities to improve the quality of life in impacted communities (e.g., economic development, replacement housing, improved community facilities). The analysis of each program package will include detailed consideration of the administrative and legal mechanisms required for its implementation.

6. Concern with both Immediate Decisions and Long-term Plans. Many of the problems of urban transportation decision making can be traced to inordinate separation of short and long term planning. Some of these are:

(a) Lack of public interest in long range planning because of the remoteness of issues being addressed.

(b) Lack of responsiveness of long range planning to considerations of political feasibility and changing community values.

(c) The tendency for master plan elements to become obsolete over long implementation periods and to be inflexibly adhered to despite changing conditions, needs and attitudes.

(d) Narrowness, shortsightedness and superficiality of analysis upon which many short term planning decisions are based, particularly those dealing with non-capital intensive investments.

Through the integration of short and long term planning in a continuing process, the impacts of immediate decisions on investment, design, pricing, operational improvements, etc., can be weighed in terms of their effects on the achievement of land use and comprehensive urban values and objectives, and on future options. Conversely, long term plan-making can be made more responsive to changing community values and priorities and to political reality by sustaining the active interest and participation of key public officials and private groups.

7. Staged decision-making. A major consequence of the integration of short and long term planning is the need to reach decisions on the implementation of some projects during the course of the Planning Review, rather than to leave all decisions to the end. Similarly, program package analyses will include consideration of alternative strategies for staging implementation of the component elements (e.g., expressways, transit extensions, local street and parking improvements, replacement housing).

8. An iterative process. Articulation of alternatives will go through several cycles at various levels of generality, gradually reducing the number of alternatives under consideration and, where appropriate, recombining elements into new program package alternatives. The aim is to encourage the flexible exploitation of emerging study results and insights throughout the Planning Review to develop improved alternatives.

Final decisions on all key elements in the study, including the selection among alternative program packages, are reserved to the Governor, an official recognition that only the chief executive can be responsible for multi-faceted decisions which have effects much broader than the appropriate jurisdiction of any of the state, regional, or local agencies involved. 1/ This executive leadership is fully responsive to recent directions of the U.S. Department of Transportation, including the placing of responsibility on the Governors for comprehensive, state-wide transportation plans. It also is a recognition of the policy thrust of the recent action by the General Court establishing ten cabinet level Executive Offices in the Commonwealth, including one for Transportation and Construction.

In order to put meaning into the participatory process, Governor Sargent anticipates following, insofar as he is able, consensus recommendations of the Boston Transportation Planning Review participants. This commitment on the part of the Governor creates a very great incentive for those in the participation process to reach agreement in order substantially to influence decisions. It also places a great burden on the state, regional, city and town representatives, as well as those representing private groups, to represent the interests and positions of the people for whom they are speaking accurately, while participating

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1/ This statement relates to all decisions within the jurisdiction of the executive branch of state government. Obviously many decisions may also involve the legislature or municipal governments, and close coordination must be obtained. Intimate involvement of key representatives of these bodies in the Steering Group and Working Committee, as explained below, is critical to these coordinated decisions.

creatively in a dynamic process of design, evaluation, and negotiation.

The planning and decision process also is designed to serve as a working prototype for future urban transportation planning in the Commonwealth, in accord with recent Federal directives and the model elaborated in the second report of the Governor's Task Force on Transportation (June 1970). 2/

The study plan itself is a reflection and a result of the participatory planning process. It is the product of intensive involvement by representatives of the following:

. . . Governor Sargent and 9 local elected chief executives

. . . state and local public agencies

. . . private institutions and associations

. . . professionals from a broad range of disciplines

The organizational structure for developing this study plan consisted of two major committees -- the Steering Group and the Working Committee. The latter, in effect, was the executive committee of the former.

Both groups were chaired by Alan Altshuler, whom Governor Sargent has designated to serve as Director of the Boston Transportation Planning Review -- working out of the Governor's Office and reporting directly to the Governor.

The Steering Group included the following:

. . . representatives of ten state bodies, ranging from the Department of Public Works and the Massachusetts Bay Transportation Authority to the Departments of Natural Resources and Community Affairs to the Joint Legislative Committee on Transportation;

. . . representatives of 9 municipalities, those potentially most affected by the major investment options to be considered by the Boston Transportation Planning Review;

2/ Governor's Task Force on Transportation, "Report to Governor Sargent, Part II," June 1970.

. . . nine representatives of private groups, ranging from chambers of commerce to associations of environmentalists and of neighborhood residents. The major categories of private interest groups were encouraged to designate one or several representatives to speak for them. This was the way in which the number of such representatives on the Steering Group was held to nine.

. . . In addition, the meetings were regularly attended by representatives of the Division Office of the Federal Highway Administration.

At an early meeting, the Steering Group decided that it needed an executive committee to work intensely with the chairman and the consultant staff. The chairman agreed that this would be desirable, and a twelve member group known as the Working Committee was formed. Each of the preceding categories of Steering Group members was allocated four seats by the chairman. The Steering Group members within each category then selected four of their number to represent them.

The Working Committee members included:

. . . representatives of the Massachusetts Department of Public Works, the Massachusetts Bay Transportation Authority, the Metropolitan Area Planning Council, and the Metropolitan District Commission;

. . . three local government representatives;

. . . one representative of the chambers of commerce;

. . . one person representing a coalition of environmental organizations; and

. . . two persons representing a coalition of neighborhood associations.

The Working Committee met two evenings a week with the chairman, several other Governor's Office representatives who frequently sat in, and consultant staff. These meetings generally lasted about four hours each, permitting full and intensive discussion of every substantial issue. All meetings were open to observers and the press, and were well attended. Steering Group

members who attended any Working Committee meeting were accorded speaking privileges. Where time permitted, observers were also permitted brief questions and comments.

One of the Working Committee's two meetings each week was designated a Steering Group meeting as well. Approximately the first hour of each such meeting was devoted to briefing the Steering Group members on the occurrences of the past week, and discussing with them any of these matters in which they expressed interest. It was agreed that the Steering Group could at any time choose to flag an issue for full-scale discussion. This never occurred, however. Rather, Steering Group members with a strong interest in particular matters made it their business to attend the Working Committee sessions in which they were discussed.

Neither the Steering Group nor the Working Committee decided anything by vote. Where they achieved consensus (most frequently, on the limits of a range), the chairman and consultant staff abided by it. Where disagreement persisted, the emphasis was on full discussion to inform the chairman's decision. It was agreed that, on major issues, appeals might be taken from the chairman's decision to the Governor.

This general structure, and these basic groundrules, are intended to characterize the whole Boston Transportation Planning Review, except that the Governor's role will largely be delegated to the Secretary of Transportation after that office comes into operation on April 30, 1971. An active effort will be made, however, to enlarge the Steering Group membership by attracting the participation of a still wider range of interests, most notably committees of the General Court, localities less obviously affected by the Boston Transportation Planning Review than those already involved, and private groups.

All activities of the Boston Transportation Planning Review will be structured to comply fully with Federal and state statutory and administrative requirements. The Steering Group and Working Committee will serve in an advisory capacity to the Governor.

Municipal and state agency representatives to the process will be expected to keep their local and agency chief executives and policy boards informed about the course of the Boston Transportation Planning Review, and report back to the Steering Group and/or Working Committee in such manner as they deem appropriate to assure a politically realistic planning process.

Specific functions of the Steering Group and Working Committee in the conduct of the work program are discussed in Section III.

The Boston Transportation Planning Review process will also develop a close working relationship with two other activities that have direct relevance to development of the Governor's Balanced Transportation Program. Those activities are:

1. A concurrent reanalysis and evaluation of transportation options for the northeastern portion of the region within Route 128 being conducted by the North Shore Planning Review (NSPR). This review will be separately funded, but administered as part of the Boston Transportation Planning Review under Alan Altshuler's chairmanship. The same general process, structure and groundrules will be followed. The NSPR concerns I-95 North between the already completed portion (about 5 miles north of Boston harbor) and Route 128, several connections to I-95, arterial improvements and public transportation improvement options within the area. The Governor has stated that the NSPR should work on the assumption that I-95 North will be built; however, alternatives involving other corridors or no Interstate highway may be studied as part of the Review.

2. An analysis and evaluation of intercity transportation requirements by a separate Task Force which will examine options of V/STOL and high speed ground transport as well as additional conventional airport and airways capacity.

The working relationship between the participatory structure and process is more fully described in Section III, Work Program and Study Process. However, the fundamental principle of a participatory process is that it is a shared experience in which there is substantive dialogue and understanding of each participant's values, priorities and perspectives. Conflict among values, criteria and priorities is almost inevitable, but a rational analysis and evaluation of conflicting positions can be achieved in an interactive process.

Lack of knowledge or expertise, failure fully to communicate the values, criteria and priorities involved, misunderstanding over the consequences of alternatives, and inability to convey the full implications of ideas and proposals can seriously compromise an interactive and participatory planning and decision making process.

For these reasons, certain features of the study plan are discussed below:

Community Liaison

A continuing liaison program, extending beyond those immediately involved with the Steering and Working Committees, and designed to facilitate the two-way flow of information, is proposed. The program will perform such functions as:

1. Briefing state and local policy boards and officials; interacting with these officials to answer questions and bringing their viewpoints to the attention of the Steering Group and Working Committee.

2. Briefing and conducting workshops for private groups, ranging from chambers of commerce and neighborhood associations, to unorganized individuals in potentially affected communities. These will be used to inform them of the study and to obtain inputs of values, alternative proposals, suggestions and criticism for both the study staff and the Steering Group and Working Committee.

Technical Assistance

The provision of expert technical assistance will enable various participants to contribute in a responsible, sophisticated and precise manner. Such assistance is required to enable both municipalities and private groups to translate their ideas into relevant, concrete proposals and to gauge the impact of potential projects on their own interests.

A Phased Work Program

In order to accommodate the necessary interaction between participants, staff, management and decision-makers, as well as to assure a process that provides for staged decision making in systematic fashion, a work program has been developed that involves several cycles of plan development, evaluation and selection.

The participatory aspects of the work program are described further in Section III, and a more detailed description of specific tasks is contained in Study Element 2 in Part Two.

Study Management

The study plan recognizes that the process described is substantially different from any metropolitan transportation planning activity undertaken in the past. For that reason, it seeks maximum specification of the roles and responsibilities of each of the participants. Specific functions to be performed are discussed in Section III and in Part Two; only general roles are treated here.

Overall study management is the direct responsibility of the Chairman, working in continuous close consultation with the Steering Group and Working Committee. The chairman is directly responsible to the Governor, who establishes broad policy guidelines and establishes deadlines.

The study staff will be composed of personnel assigned by the various public agencies, consultants working under contract, and locally based organizations which have the legal and technical capacity to undertake elements of the work program.

The Governor's representative will serve as chairman of the Steering Group and Working Committee and as Study Manager. In the latter capacity he will direct the study staff in the conduct of all aspects of the work program including the provision of technical assistance to private groups and municipalities as needed.

The study staff will be responsible for obtaining data, proposals, design inputs and other information from state and regional agencies, municipalities and private groups for providing technical assistance to participants as assigned, for keeping all participants informed on an interactive basis of emerging study element outputs, and most importantly, for seeking to translate their concerns and priorities into plans and designs under the guidance of the Study Manager.

The Committees are responsible for making recommendations to the Governor on the implementation of any programs or projects during the course of the study, in full recognition that elements of a complex transportation system are to be developed or improved in a staged decision making environment.

The Governor, in turn, will make all final decisions on recommended programs which are within the purview of the Commonwealth's executive branch and will obtain public agency review and comment before submission to the Federal Government for review and approval. The Governor will also give fair consideration to:

(a) results of required public hearings,

(b) results of widely publicized public meetings to be held at all major decision points during the study, and

(c) positions, including dissenting views of participants, which will be transmitted with other study results and recommendations to him.

Legislation

The study plan recognizes that the planning activity may well produce results which would require legislation to implement. For that reason, representatives of the Joint Legislative Committee on Transportation and possibly other appropriate

legislative committees will be invited to participate or at least attend and observe committee meetings.

Draft legislation will be developed by the planning process if and when it is necessary and will be submitted to the Governor for his consideration.

At the beginning of this Section it was noted that a principal characteristic of this study plan is that alternative "program packages" will be designed, evaluated and selected for implementation. It is highly unlikely that program packages can be developed which can be implemented wholly within the statutory jurisdiction and resources of any single state, regional or local agency. Some adjustment of statutory responsibility and authority may be required as noted in the legislative section above. However, it is likely that program packages can be developed within the authority and responsibility of state and local agencies working cooperatively.

The study plan, therefore, provides for the development of program packages with identification of responsibility for implementation of elements and resources necessary to carry them out.

The thorough involvement of state and regional agencies, municipal governments and private groups offers the opportunity to have a very direct influence on the course of planning for a Balanced Transportation Development Program. The involvement carries with it an obligation and commitment fully to utilize respective authorities, abilities and resources to carry out the implementation of programs and projects resulting from the process.

The Study Manager and staff will continually cooperate with agencies and municipalities to assure integration of this study plan with ongoing programs and services and to secure full coordination in the implementation of program packages.

SECTION III

WORK PROGRAM & STUDY PROCESS

The purpose of this section is to describe the broad framework of the work program, relate it to the planning and decision making process, and set all of the more detailed material on criteria, alternatives and study elements contained in subsequent sections into an integrated context. More specifically the following will be covered in this section:

. . . Important distinguishing characteristics of the Work Program

. . . Present status of the process; accomplishments and unfinished tasks begun

. . . Principal participatory aspects of the Work Program

. . . The need for an iterative plan-making process

. . . Description of the phases of narrowing and refining alternatives

. . . Sequencing of the major study functions, communications, reports and decisions

. . . The relationship among criteria, alternative program packages, and study elements

Important Distinguishing Characteristics of the Work Program

At the beginning of the previous Section the primary characteristics of the study plan were described as they relate to the decision making process. Here we wish to add a few comments on additional characteristics which have shaped the Work Program. The characteristics listed were:

1. The process is to be participatory but decisive.

2. It is multi-valued in orientation.

3. It is multi-modal.

4. Equity is a guiding principle.

5. Decisions will be made on program packages.

6. The process will be concerned with both short and long term plans.

7. Staged decision making will be required.

8. An iterative process will be followed.

The first characteristic places major demands on the work program. The Community Liaison and Technical Assistance programs were introduced in the previous section. The subsection which follows describes the manner in which many groups have participated effectively in the process to date. The third subsection discusses specific plans for participatory aspects of the work program and identifies where in the remainder of the document greater detail can be found. Every Study Element and every aspect of the process is not only open to participation, but will actively seek it throughout the work program. The experience during the Study Design period has demonstrated the effectiveness with which participation of all major interested groups can be obtained at a high level in the process -- that of the Steering Group and Working Committee. The other mechanisms (technical assistance, workshops, briefings, public meetings, hearings, etc.) are designed to obtain a variety of other levels of participation appropriate to the interests and desires of all concerned -- state and regional agencies, localities, private groups and individuals.

The multi-valued orientation of the process is a response to the broad range of concerns, values and issues that have been raised relating to transportation decisions and their impacts. With the aid of the consultant, the participants have translated these into a comprehensive set of criteria -- a set of dimensions or scales organized in a systematic framework to be used for guiding the design and evaluation of alternatives in all phases of the study. These criteria and their application are described in Section IV and in Study Element #3.

The multi-valued nature of the process also requires it to be interdisciplinary. The process has involved an integrated staff including the disciplines of political science, law, systems analysis, engineering, transportation planning, urban planning, economics, sociology and environmental planning. The Study Elements defined in Part Two will continue to require these disciplines and other persons with expertise in architecture,

ecology, housing, and labor relations. It is essential that these Study Elements, and therefore the several disciplines, be highly coordinated to satisfy the demanding requirements of this study. The management requirements section of Part Two (Study Element #1) discusses this task.

Because it is to be an integrated multi-modal process, all components of both the highway and transit systems must be designed and evaluated as a whole so that all parts are in balance, so that each part is utilized to best advantage and complements the rest of the system, and so that all transportation needs are served. Study Elements #4 (Transportation System Design), #6 (Land Use and Travel Forecasting), #7 (Special Mobility Studies), and #8 (Technological Planning) accomplish this work.

Concern with both immediate decisions and long term plans requires that consequences of alternatives (the measurement and prediction of values for all criteria) be evaluated for short as well as long term horizons. It also requires that alternatives and selected plans be explicitly time staged. Greater attention will be given than in previous studies to the possibility of accommodating future traffic through transit innovations and less capital intensive means such as operational improvements to the existing system of highways and transit.

A major portion of this section is devoted to an explanation of the iterative nature of the process and the manner in which the work program has been designed to facilitate staged decision making. Three basic cycles of design, evaluation and selection of alternatives are scheduled over an 18 month period. The process will move from sketch plans (Phase I) to refined detailed designs (Phases II and III) with implementation decisions being made throughout. Continuing feedback will assist in making the participatory process effective, developing consensus to the extent possible, and narrowing the range of choices.

These three cycles of plan making are viewed as establishing the format for a continuing transportation planning process for the eastern Massachusetts region and possibly for other urbanized areas of the State.

It is important to emphasize that this study plan is intended to provide a new format for continuing cooperative comprehensive transportation planning. It is a new context for the planning work for which existing State agencies are responsible, and not an additional planning process separate from or in addition to agency planning activities. Existing agencies, municipalities and other local groups will have responsibility for much of the work program and all of the work will be carefully coordinated

with other related planning activities, such as the TOPICS program, the Leverett Circle Bridge study, the South Shore rapid transit extension and so on.

Present Status of the Process

Active, broad participation in the current study process began with the creation of the Steering Committee in late July. After initial attention to organizational, procedural and general policies governing the process, participants began preparing statements of their desired emphases and priorities for the Boston Transportation Planning Review.

The intensity of participation in the process is illustrated by the amount of effort put forth by participants. The preparation of position papers involved numerous drafts and review meetings with the consultant and with policy groups of the various private groups, municipal caucus and State agencies, in addition to the 6 to 10 hours per week of meetings of the Steering Group and Working Committee. The preparation of position papers, various discussion papers, inputs to drafts of this report and reviews of consultant memoranda and drafts consumed enormous amounts of time. Many participants worked substantially full time and perhaps a majority of Working Committee members and several others devoted over 50 per cent of their time to the process. 1/

During August a consensus began to emerge on the general scope and outline of the study process. Value statements were developed into initial criteria to be used in the design and evaluation of alternatives. The municipal caucus 2/ provided a paper serving as the first draft, which was augmented by criteria on special mobility needs, community quality and other factors by the Greater Boston Committee on the Transportation Crisis 3/, and by criteria on environmental and conservation factors prepared by the conservation participants. The consultant structured these and other inputs, and after several rounds of drafting, debating, and revising, the version contained in Section IV has evolved.

1/ Close to 100 memoranda were prepared by participants during the study design phase.

2/ The municipal caucus is an informal arrangement among the participating cities and towns whereby common concerns and positions are discussed and developed for the Steering Group and Working Committee. It has proven of great value in building consensus and facilitating communications. It does not keep strong differences of opinion from the larger process.

3/ GBC is a coalition of neighborhood associations formed to further common cause on transportation issues.

Participants view this as a working set of criteria which has guided other parts of this study design, but which is subject to change. Prior to formal beginning of the actual study these criteria, as well as other aspects of the study design, will be widely reviewed in the region, as well as in Washington. As each of the major study phases begins, the criteria will be revised and refined based on reviews by participants and experience from previous work. During the first phase in particular, minimum and desirable standards will be developed for design of alternative program packages.

A similar process began in August for the transportation corridor and system alternatives. Debate on these, as expected, was most intense and involved the widest range of views. Drafts needed to be very substantially modified at each round. However, despite differences, some degree of agreement and substantially improved communication is evolving. Consensus has been reached, for example, that considerably increased attention should be given to TOPICS type improvements and "coverage" (local service) transit service in the core cities. A consensus has been reached on the range of alternatives to be studied and these are defined in Section V. Only previously planned expressways and rapid transit lines are definitively identified. Other transportation elements have been defined in general terms (type of service, function and general location), and they are subject to modification as the study enters the formal design work in Phase I.

The general methodology for the study evolved slowly throughout the study design phase. Experience in the conduct of the Steering Group and Working Committee business necessitated an evolution of the groundrules for participatory aspects which have been incorporated in this study design. The nature of the alternatives and the key issues to be addressed dictated the use of analytical methods which are capable of dealing both with questions of broad regional system efficiency and with highly localized issues of mobility, community impact and operation of individual elements of the transportation system. These requirements fit well with the desire to plan an iterative process to accommodate needs of the participatory process and the desire to stage decisions throughout the study period.

The definition of criteria and alternatives to be studied led directly to identification of most of the particular studies needed. Some Study Elements (or portions thereof) were called for by participants concerned with the feasibility of implementing program packages as intended, and others by participants who identified particular opportunities to improve local conditions or solve problems as part of possible program packages in a corridor. Drafts of Study Elements went through substantial revision as a result of participants' reviews.

A last phase in the development of the study design was the allocation of budget to Study Elements. The consultant prepared an estimate of the range of costs of each element and sub-element, based on varying assumptions as to the depth and scope of work for each. After full discussion in which all viewpoints were aired, consensus emerged on a narrow range for most of the budget elements. The final budget was determined by Governor's Office decision, seeking insofar as possible to accommodate the various viewpoints expressed. In several cases these discussions resulted in improved definitions of scope of work and modifications to the substance of Study Elements.

Principal Participatory Aspects of Work Program

The process will be highly participatory, as has been discussed in the preceeding section. Incentive for participation has been achieved because the study will deal with difficult near-term decisions as well as more remote long-term transportation system plans. Also as has been discussed, the process will be closely tied to the process of decision-making by elected and appointed officials in the executive and legislative branches of State and local government.

Participation will be achieved through direct participation in the work of the Steering Group and Working Committee as described in the previous section, through more informed feedback mechanisms during the study process, and through full-scale public hearings on major projects that the Governor decides to implement.

Study Element #2, described in Part Two, will provide technical assistance by professional study staff to municipalities and interested private groups to assist them in developing proposals and in gauging the potential impact of proposals upon their values and interests. This technical assistance will be allocated on the basis of need to groups seeking it, and will be under the supervision of the Study Director, working in close consultation with the Steering Group and Working Committee.

Study Element #2 also provides for a series of workshops. Workshops will be held in communities which would be directly affected by proposed transportation projects and perhaps elsewhere as the need is determined. Early workshops will be devoted to describing the process, developing minimum, maximum and desirable standards to guide the study, and developing initial sketch plans. As sketch plans are developed, workshops will be devoted to discussion of them. In later phases of the process involving more detailed plans, a similar sequence of workshops will be conducted.

The objective of achieving a truly effective, as well as decisive, participatory process is the principal reason for planning a work program which involves several phases of plan development, evaluation and selection. A single cycle is inadequate to obtain the necessary interaction between interested participants, staff, management and decision-makers. This cyclical design, evaluation and selection process will be described further below.

The above requirements place heavy demands upon communication in the work program. The monthly progress reports of the study management described below will be circulated among all interested groups to keep them informed and to notify them of planned public meetings and hearings, workshops or forthcoming decisions. Meetings to discuss work with study staff will be held at the request of interested groups to the extent feasible.

In addition, most of the Study Elements described in Part Two will involve important communication and interaction with participants and interested groups. Those studies dealing with special mobility needs and with complementary components of program packages (environment, housing, business relocation, employment, neighborhood cohesion, regional economy and joint development) will particularly require substantial inputs and involvement of participants in the form of surveys and advisory committees. All design work for both transportation and complementary components within particular corridors or communities will proceed in close communication with special subcommittees established for those areas. Results of all design and technical evaluation work will be distributed for review.

Maximal openness will be required. All Working Committee, Steering Group meetings and Workshops will be at announced times and places and open to the public. The status, location and availability of all project materials will be communicated through monthly progress reports. All working materials will be open to interested groups for inspection to the extent feasible.

Public meetings will be held at all critical points in the study process when important decisions are to be made. These will be well publicized, held at convenient locations, and open to the general public.

Iterative Aspect of Work Program

In the above discussion, three characteristics of the study have been identified which tend to require a process involving several cycles of analysis and plan-making.

1. A participatory process calls for continual feedback

between interested groups and staff involved in technical aspects of plan-making.

2. Since near term decisions on transportation facilities are major concerns of the study, it would be unwise and costly to postpone all decisions until the end of a single major period of analysis and selection of alternatives. Hence the process must provide information for several rounds of decisions.

3. Transportation issues range from regional system configuration and impact to fine-grained, neighborhood-level questions of mobility, access and impact. Different analytical methods and tasks are clearly needed at these different scales, yet there are obvious relationships between the choices made at the two scales. Feedback must occur between the different types of analysis and decision-making.

For the above reasons three intensive cycles of plan-making have been scheduled for the 18 months of this study, during which critical decisions are required on the Interstate system and other major projects. During this period a continuing planning process will be established building upon this study process.

The desirability of establishing a planning process with relatively frequent iterations of design, evaluation, selection and decisions on implementation was a major conclusion reached by Boyce and Day in their review of recent major metropolitan land use and transportation planning programs for the U.S. Bureau of Public Roads. 4/

Since the type of process developed for this study represents a break from traditional practice, it deserves further explanation.

A key principle governing the design of this study is that the work program must build upon and make use of the wealth of existing data, analysis techniques, and results of previous studies as much as possible without compromising significantly the objectives of the study. The values and policy assumptions inherent in the previous work should be explicitly considered and understood in order that these may be carried forward or changed by participants.

The data and forecasting work to be used as basic building

4/ Metropolitan Plan Evaluation Methodology, University of Pennsylvania, March 1969.

blocks derives from the EMRPP, the DPW "Task A" work 5/, work of particular state and city agencies, work of consultants with Boston data for clients in and out of the region, and work carried out at M.I.T. Major new data collection cannot be part of this study.

Conventional travel forecasting and other related techniques applied in previous studies should be used for those aspects of the work program for which they are best suited. They have been widely used and accepted for testing and refinement of regional arterial, freeway and rapid transit networks to provide data for engineering design work. However, they are expensive and time consuming to operate and not well designed to test the widely varying types of transportation systems and policies which this study is committed to address, nor are they suited to deal with very fine-grained analyses of mobility, access and impact at the neighborhood scale.

Despite the limitations of previous methods, no other planning tools have yet been developed which have the proven capability and acceptability of conventional transportation planning methods for the purposes they have been designed to serve, the thorough testing and refinement of networks and the provision of data for engineering design.

To accommodate this decision, the work program must provide substantial time for this phase of the work. Also because of the amount of time and cost required for use of these methods, it is necessary to substantially limit the number of alternatives and variations on alternatives that are subjected to testing with these techniques.

Other approaches must be taken to provide the additional capabilities demanded by the requirements of this study, i.e. the testing of a large number of widely varying alternatives.

Large scale differences may exist in the widely varying system alternatives to be analyzed. Great detail need not be required in the methods used to evaluate and select from among such widely differing alternatives. Only that level of detail, in terms of land use, housing impact, travel data, costs, community cohesion, etc. required for evaluation, refinement and selection need be included. This applies to alternatives at both the regional

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5/ Task A was a recently completed, but as yet unpublished study sponsored by DPW and requested by FHWA to determine the need for the Inner Belt through eastern Cambridge from a traffic service standpoint.

and corridor scales. For example, it may be possible to reach consensus on the superiority of one configuration of regional rapid transit lines and expressways in contrast to another substantially different configuration using methods and techniques other than conventional detailed network models, detailed precise housing, environmental and employment studies, engineering cost estimates, etc. Similarly a choice might be possible for one type of rapid transit facility over another basically different type in a corridor, using methods which yield fairly aggregated data and provide coarser estimates than conventional methods.

There can be no guarantee, of course, that such analysis will lead to consensus or show the clear superiority of alternatives. The important point is that if adequate rapid sketch planning methods are used in the initial phase of the study, attempts can be made to reach certain types of decisions in the first phase. These decisions might be of the following nature:

1. To select a project (highway, transit line, demonstration of a new type of service, etc.) and associated program package elements for implementation;

2. To select a project for more detailed design work required before implementation;

3. To eliminate from further consideration a project, set of projects, or possibly an entire alternative system;

4. To modify the sketch design in subsequent, more detailed studies or in a second round of sketch planning;

5. To combine components of different alternatives or add new components to form new system alternatives for further study.

The primary requirements for these sketch planning methods are:

1. They must be capable of rapid execution.

2. They must be capable of yielding estimates of the expected consequences of widely varying alternatives.

3. The results they produce must be consistent with those for the more detailed conventional methods to be applied in subsequent phases.

4. They must provide the capability for estimating all important differences among alternatives.

5. The sketch planning methods, together with the more detailed methods, must be structured to provide for a cyclical process of design, evaluation, selection, redesign, ... The key to this is the fact that the same information (the criteria of Section IV) that is used for evaluation and selection is used for design. These criteria should also be used to develop design principles, as an integral part of the work, to provide efficient means for seeking optimal designs.

Sketch planning methods meeting these requirements have been developed. They include sketch planning and sketch design approaches used in the urban planning and architectural professions; the use of informed judgment based on the best available data, models or studies; the use of panels of experts and local advisory committees; the use of available new methods of forecasting traffic based on economic demand theory; the use of limited, small sample surveys; and cost estimating based on aggregate, rather than detailed, unit cost experience.

Descriptions of both the sketch planning and the more detailed methods are contained in Part Two.

Scheduling of Study Phases and Major Study Functions

The study phases may be defined in terms of timing and in terms of the major study functions as follows:

Study Design Phase -- the work leading to the preparation of this report, as described earlier in this section. The major functions performed were development of the study design, the study process, methodology and work program, the initial criteria, and the broad alternatives to be studied.

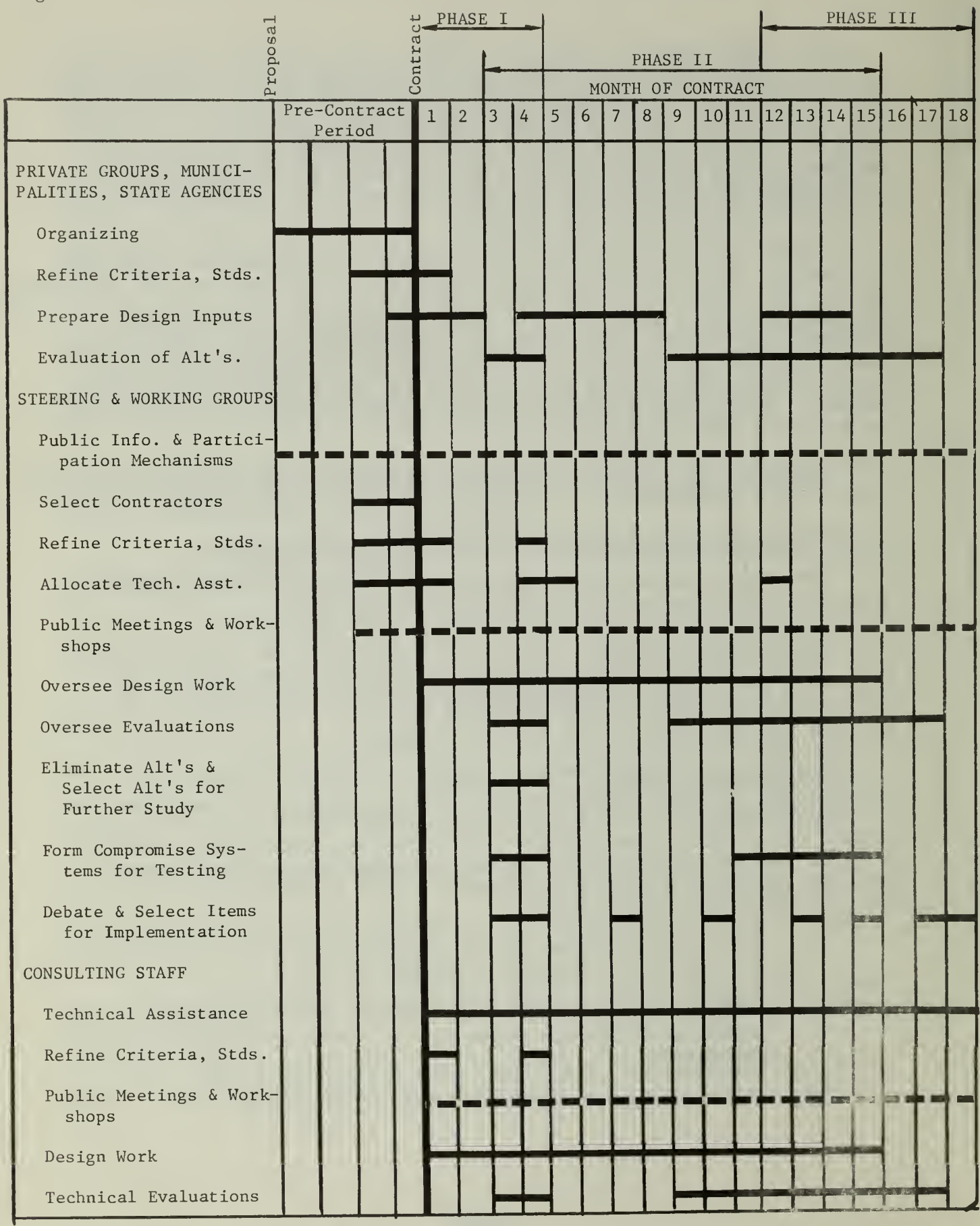
Pre-contract Phase -- the period immediately following the preparation of this report during which a series of functions are to be performed by participants to prepare for the actual study. Figure III.1 shows the schedule for this and succeeding phases with an assumed four months between submission of this report and the letting of initial contracts. The major functions during the Pre-contract Phase include:

(a) further organizing by private interests and others to participate effectively in the study;

(b) introductory workshops to contact and involve all groups who wish to participate actively through this mechanism;

(c) additional work on refinement of criteria;

Figure III.1 SCHEDULE FOR PHASES AND MAJOR FUNCTIONS OF STUDY PROCESS



(d) initial development of minimum, maximum and desired standards for selected criteria, including goals for land development;

(e) initial efforts to develop design inputs by participants;

(f) refinement of alternatives;

(g) the selection of contractors;

(h) the allocation of technical assistance among participants for Phase I work;

(i) providing public information on the study;

(j) making any necessary adjustments in the framework for participation to accommodate representation of new interests; and

(k) the establishment of subcommittees or advisory committees to handle various Study Elements or subregional portions of the study.

Those functions which are to be performed at frequent intervals throughout the process (public meetings and workshops, preparation of public information, allocation of technical assistance and the selection of items for implementation) cannot be definitely scheduled now since their timing will be affected by decisions which cannot be forecast. Dashed lines on Figure III.1 are to indicate occurrence at frequent intervals.

Phase I -- the first four month period of the actual study, during which the first of several plan-making cycles will occur. The pre-contract functions of refining criteria, developing minimum and desirable standards and development of design inputs by participants will continue with the aid of technical assistance from the consultant staff. Sketch plan designs will be prepared and technical evaluations performed by staff. A series of public meetings, workshops, and reports on work accomplished, together with the availability of technical assistance, will enable interested groups to participate in the sketch plan design process and to perform their own evaluations and communicate them to the Steering Group and Working Committee. The latter groups will use all of the above results to attempt to reach consensus on implementation of components of alternatives, elimination of alternatives or components from further consideration, or selection or modification of sketch plans for further study in Phase II. Additional sketch planning work may be necessary in order to further narrow the range of alternatives selected for more thorough study or to test variations or compromises among Phase I

alternatives. It should be possible to complete additional cycles of sketch planning work in substantially shorter periods of time than Phase I because of the experience gained and the likely similarity to previous designs. One to three months per additional sketch plan cycle will be required depending on the degree of similarity and the nature of the issues involved.

Phase II -- a period of thirteen months beginning with the third month, encompassing the primary detailed plan-making cycle. As can be seen on the scheduling chart, the functions are approximately the same as for Phase I. Some of the Phase II functions can begin before Phase I is complete: refinement of criteria and standards, allocation of technical assistance, and any design work which can be anticipated as needed regardless of decisions made in Phase I.

Phase III -- a final period is reserved for design and evaluation of compromise alternatives which may result from previous cycles. Many previous studies have had to go through this phase inadequately because time and resources for this negotiation and resolution process had not been budgeted. Essentially the same functions are scheduled as for Phase II, except that refinement of criteria and standards is not expected to be required.

Study Elements and Their Relationship to Study Phases, Criteria, and Alternative Program Packages

The detailed work program descriptions in Part Two are organized by "Study Elements", a series of 14 categories of work to be performed, broken down by subject area of work for convenience of exposition. (It would have been possible, but less convenient, to have organized Part Two by study phase or by major function.) The 14 Study Elements and their purposes in brief are:

General Study Elements -- Those Study Elements dealing primarily with study management, mechanisms for participation and the general process for evaluation of alternatives, rather than with specific technical aspects of design, evaluation and implementation of alternatives.

1. Study Management -- to provide immediate staff for the Steering Group and Working Committee, to provide the major creative effort in formulation of alternative program packages in response to values and priorities of participants, to oversee and coordinate the work of all other staff performing other Study Elements, and to handle arrangements for all public meetings, workshops and major communications.

2. Community Liaison and Technical Assistance -- to provide

adequate communication and interaction mechanisms for the continuance of the participatory planning process throughout the study; and to provide substantive technical assistance to those participants who lack sufficient resources to play an effective part in the study.

3. Use of Design and Evaluation Criteria -- to refine the criteria used for design and evaluation in each study phase; to develop minimum, maximum and desirable standards for selected criteria, including land development goals; and to synthesize all evaluation measures in the form of overall benefit-cost comparisons and other summary comparisons to assist the Steering Group, Working Committee and other participants in performing their evaluations and arriving at recommendations for implementation.

Transportation Elements -- Those Study Elements dealing primarily with the design and evaluation of transportation components and systems and the joint development work necessary to integrate other facilities and services with transportation components.

4. Transportation System Design -- To design each of the transportation system components (expressways, arterials, rapid transit lines, terminals, local service ("coverage") transit system improvements, various operational and TOPICS type improvements), in coordination with all other Study Elements involved in the design work, and to provide information on those criteria dealing with transportation service and costs.

5. Joint Development and the Development of Alternative Program Packages -- To identify and relate complementary components of the alternative program packages, to integrate them with the Transportation System Design elements, and to design the total program packages in appropriate detail for evaluation.

6. Land Use and Travel Forecasting -- To forecast the effects of the alternative transportation systems on regional patterns of land use and intensity of development; to forecast travel on all parts of the system, taking into account competition among modes, effects of congestion, fares, tolls and parking fees; to provide information on the achievement of those criteria dealing with operating costs, service levels and land development goals; and to provide information on transportation user effects by type of group.

7. Special Mobility Studies -- To assess needs and develop

recommendations to meet previously unmet or latent transport needs, with particular reference to especially disadvantaged groups, e.g., autoless households, the unemployed, the disabled, the elderly, and those too young to drive.

8. Technological Planning -- To identify those near term innovations of high potential benefit to the Boston area for incorporation in the transportation system alternatives; and to provide information on longer term innovations which should be planned for, so that current system designs can accommodate them readily when they become available.

Implementation Element

9. Administrative and Legislative Studies -- To address the problems of implementation of program packages and the framework for continuing transportation planning, under the following functional headings:

   (a) Administrative cooperation and delivery systems

   (b) Feasibility of implementation of alternative program packages

   (c) The participatory process and the restudy

   (d) An analysis of existing and proposed State and Federal regulations and legislation

Transportation Impact Elements -- Study Elements dealing primarily with transportation impacts and the design and evaluation of aspects and components of alternative program packages which are complementary to transportation components.

10. Environmental and Conservation Studies -- To assess the impact of alternative program packages on ambient noise levels, air pollution, visual intrusion, and the positive and negative effects on natural features, ecosystems, open space, park lands, and symbolic and historical assets; and to integrate this impact information into the process of evaluating alternatives and the process of locating and designing transportation facilities.

11. Effects of Alternatives on the Regional Economy -- To assess the absolute and relative impacts that the alternatives can be expected to have on:

(a) the costs, growth and effectiveness of operation of long-haul goods movement, including containerization,

(b) the gross regional economy and its sectors,

(c) the costs of doing business, producing goods and providing services,

(d) the ability of the region to compete with other regions in retaining and attracting firms or encouraging expansion within the region,

(e) attracting tourists to the region, and

(f) affecting the size of Boston's economic hinterland and therefore on the size of distributive industries and the volume of interregional trade.

12. Family Relocation and Replacement Housing -- To provide specific data on the number, type and special characteristics of families who would be relocated under each of the alternative program packages to be evaluated; to use this impact information in the evaluation of alternatives and in the design and redesign of alternatives; and to develop a replacement housing and relocation program as part of the recommended program packages.

13. Business Relocation and Employment -- To develop specific data on the number, type and special characteristics of business which might require relocation under each of the alternative program packages to be evaluated; to examine current procedures, agency responsibilities and legal requirements; to develop a replacement and relocation program for displaced businesses; to evaluate the comparative effects of alternative transportation systems in attracting needed job opportunities; and to use this information to aid in the transportation system design process.

14. Neighborhood Cohesion and Transportation Needs -- To identify and measure the degree of social interaction and neighborhood cohesion and the importance of neighborhood identity; to assess special local transportation problems, opportunities and needs; to assess the importance of existing and potential internal and external linkages; to analyze disruption problems which have occurred in the past during right-of-way acquisition, demolition and construction; to use this information to aid in the transportation system design process

and in developing improved means for alleviating recognized problems; and to analyze, measure and evaluate the extent to which alternative program packages disrupt neighborhoods by severing or hindering linkages, inducing through traffic, etc. or the extent to which they improve cohesion and alleviate existing problems.

As can be seen from the above brief description, almost all of the study elements will be involved in both the design and evaluation processes and in all of the phases of the work program. The relative degree of effort of the Study Elements on these two functions does vary. None exclusively involves design. Only #11 (Regional Economy) exclusively involves evaluation. Those which require substantially greater effort on design include #3 (Transportation System Design) and #5 (Joint Development...); however, even these are responsible for producing information on important evaluation criteria including most of the data on capital costs.

Most of the transportation impact elements (environmental and conservation, housing, business relocation and employment and neighborhood cohesion) will be directly integrated into the design of transportation facilities (particularly the location studies) as well as the design of complementary components of program packages and the evaluation of both types of components.

For these reasons it is important that the Study Elements be highly integrated in the study rather than treated as independent, merely coordinated, tasks.

In all study phases, the evaluations of alternative program packages will make use of work from all Study Elements. In the next Section, Figure IV.1 lists the specific Study Elements which will be responsible for producing information on each of the dozens of criteria to be used in each round of evaluations. All Study Elements except #1 (Study Management) and #2 (Community Liaison and Technical Assistance) are responsible for producing some measures of criteria. 6/

6/ Both of these Study Elements will be quite important in the evaluation process, however. The study management will have primary responsibility, of course, for overseeing the technical evaluation process and organizing the results for the Steering Group and Working Committee. The Community Liaison and Technical Assistance work will have responsibility for assisting participants prepare their own evaluations of alternatives based in large part on the results of the technical evaluations, and these community evaluations will be fully communicated to the Steering Group and Working Committee along with all technical evaluations.

All measures of criteria will be applied to each alternative. Thus, results from 14 Study Elements are necessary for evaluations of all alternatives at each phase, from sketch planning to final detailed plan-making.

Schedule for Reports

Figure III.2 shows the schedule for major reports which will be produced for distribution among all participants. In addition to these major reports, numerous working papers will be distributed to participants throughout the study to keep them informed and assist them in effectively participating. These working papers will be supplemented by drawings, maps, charts and sketches to communicate progress and results of all design work at the workshops, public meetings and briefings as well as Steering Group and Working Committee sessions.

These informal interim reports, working papers and graphics will form a primary basis for interaction among participants during the study. Scheduling of these informal documents is not shown on Figure III.2 because of their great number and because of the flexibility required.

Monthly Progress and Management Reports (A) will cover the status of all Study Elements and study phases and inform participants of the availability of materials, schedule of meetings, etc. Public Information Reports and Briefing papers (B) will be prepared periodically as needed, not necessarily according to the schedule shown in Figure III.2. They will draw on all other reports as appropriate. For example, a summary of the report on sketch plan designs (D) might be used for early widespread public distribution and briefings to meetings of various regional interest groups and officials.

A series of technical assistance reports (C)will be prepared by the staff to cover the assignments to assist the various participants. These reports are intended to aid the Steering Group and Working Committee in evaluating the effectiveness of these assignments and providing guidance for subsequent assignments.

Reports D, E, F and G will contain summary results of Phase I and II work, and will therefore draw on results from all Study Elements. The Final Report on the Study (S) will similarly cover all Study Elements and all study phases and will include a recommended program for the continuing planning process.

The remainder of the reports (H through R) cover major recommendations that will be developed.

Location Study Reports (H) will be prepared for all major

Figure III.2

SCHEDULE OF REPORTS

	PHASE I / PHASE II / PHASE III — MONTH																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A. Monthly Progress and Management Reports	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
B. Periodic Public Information Reports, Briefings				X				X				X			X			X
C. Series of Technical Assistance Reports				X				X				X			X			
D. Sketch Plan Alternative - Preliminary Designs for Each Alternative			X															
E. Technical Evaluation of Sketch Plans				X														
F. Design of Alternatives - Phase II Report												X						
G. Technical Evaluation of Phase II Alternatives															X			
H. Location Study Reports for Major Line Haul Transportation Facilities												X						
I. Preliminary Design Reports for Major Transportation Facilities																	X	
J. Joint Development Preliminary Design Reports																	X	
K. Replacement Housing Program for Recommended Corridors																	X	
L. Business Relocation and Employment Report																	X	
M. Plan for Mgmt. of Property, Provision of Needed Services & Maint. of Comm. Sfty. & Integrity during R-O-W Acquis., Demolition & Construct.															X			
N. Coverage Transit Improvement Program												X						
O. Traffic Operations Improvement Program												X						
P. Project Plans for Demonstrations			X						X									
Q. Technology Report - Demonstrations and R&D Program												X						
R. Administrative and Legislative Study Report					X													X
S. Final Report on BTS - Recommendations for Continuing Process																		X

line haul transportation facilities for which location alternatives were carried through Phase II. These reports will describe the alternative locations and report the results of the comparative evaluations, including results of application of the criteria from all Study Elements. All Federal requirements including planning for environmental protection will be fully met.

Preliminary Design Reports (I) will similarly be prepared for all major transportation facilities for which locations have been agreed upon and preliminary engineering work completed. For such facilities involving potential joint development work, Preliminary Design Reports (J) will also be prepared covering preliminary engineering, preliminary architectural design, preliminary site design, design features necessary to protect the environment, and plans for other components of program packages that are included.

Because of the importance of certain program components and the fact that their implementation involves actions quite distinct from physical design and construction, separate reports are planned for the Replacement Housing and Relocation Program (K), Business Relocation and Employment (L), and the Plan for Management of Property, Provision of Needed Services and Maintenance of Community Safety and Integrity During Right of Way Acquisition, Demolition and Construction (M).

The Coverage Transit Improvement Program report (N) will contain recommendations and results of analysis on new and improved local transit services for core communities. Included will be plans for new bus routes, increased frequency of service for buses and streetcars on specific routes, special new services to provide access to jobs and other activities of critical value to core communities, and results of analyses of costs of providing services and expected benefits to be realized.

The Traffic Operations Improvement Program report (O) will contain interim results of the Boston area portions of the TAMS' statewide TOPICS study 7/ which will be closely integrated with this work program. It will also contain results of additional work augmenting the TAMS contract, since greater emphasis on traffic operations improvements, particularly for facilitating transit service, has been called for by the Steering Group and Working Committee.

7/ A study being conducted by Tippetts-Abbett-McCarthy-Stratton, Engineers and Architects for the DPW to perform traffic operations planning and design services for selected urban areas of Massachusetts.

Project Plans for Demonstrations (P) will be prepared for those smaller scale demonstrations for which consensus can be reached, and which can be financed and initiated during the course of the study period.

A Technology Report (Q) will cover recommendations for demonstrations of innovative systems, services or components from existing technology, and recommendations for actions that should be taken to encourage or directly finance research and development of new systems having high potential benefit in the Boston region.

Two Administrative and Legislative Study reports (R) are planned. The first is scheduled shortly after the completion of Phase I and will deal with mechanisms needed to take full advantage of new Federal transit and highway legislation, findings of the first phase evaluation regarding feasibility of implementing program packages, and mechanisms or legislation which are fairly certain to be needed to carry out recommendations expected to result from the process. The second report is scheduled at the end of Phase III and will contain detailed recommendations on administrative plans and legislation required to implement all of the study recommendations.

Summary Budget

The summary budget recommended for the 18 month study period is shown on the attached table. Estimated costs of the study are shown (in the first three columns) by Study Element, for each of the three study phases. In addition to these costs, ranges of costs are shown for each Study Element for the later two phases (second-to-last column). The total cost of each phase of the study is shown in the bottom rows of the table: Phase I--$839,000; Phase II--$1,902,000 (range $1,700,000 to $2,100,000); Phase III--$759,000 ($550,000 to $950,000). Total cost of the study is estimated at $3,500,000.

All estimated costs are based on detailed cost estimates shown in Part Two and are the best current estimates of costs of performing each of the Study Elements as described in Part Two.

The reason for showing ranges of costs for later phases is that the precise scope of that work must depend on results of early work -- decisions on selection and elimination of alternatives, the specific nature of program packages being designed, and the relative emphasis that needs to be placed on various criteria in order to facilitate decisions and address concerns responsively.

The study budget must maintain sufficient flexibility to permit modifications in allocations among Study Elements as the

Figure III.3 Budget Summary by Study Element and by Phase

Showing Ranges of Cost Desired for Flexibility in Later Phases

Study Elements	COSTS BY PHASE (000's) I	II	III	Totals	Estimated Ranges II &III	Total
General Study Elements	$154	$387	$169	$710		
1. Study Management	60	170	100	330	$240-300	$300-360
2. Community Liaison & Technical Assistance	80	205	65	350	245-295	325-375
3. Use of Design & Evaluation Criteria	14	12	4	30	10-25	25-40
Transportation Elements	$495	$1170	$410	$2075		
4. Transportation System Design	170	505	85	760	430-790	600-960
5. Joint Development & the Development of Alternative Program Packages	70	280	150	500	380-630	450-700
6. Land Use & Travel Forecasting	215	325	160	700	485-700	700-915
7. Special Mobility Studies	28	43	4	75	30-90	60-120
8. Technological Planning	12	17	11	40	20-45	30-55
Implementation Element	$20	$35	$25	$80		
9. Administrative & Legislative Studies	20	35	25	80	45-85	65-105
Transportation Impact Elements	$170	$310	$155	$635		
10. Environmental & Conservation Studies	35	75	40	150	95-135	130-170
11. Effects of Alternatives on Regional Economy	20	40	20	80	50-70	70-90
12. Replacement Housing & Family Relocation	65	115	55	235	130-230	195-295
13. Business Relocation & Employment	40	60	30	130	70-150	110-190
14. Neighborhood Cohesion & Transportation Needs	10	20	10	40	20-40	30-50
TOTALS	$839	$1902	$759	$3500		
Range		$1700-2100	$550-950	$3100-3900		

study progresses. Precise commitments to budget allocations now for later phases would hinder this needed flexibility.

The lower bounds on each Study Element budget are based on the assumption that the number of alternatives will be reduced substantially at the end of Phase I and the degree of concern over issues related to that Study Element will be as moderate as can now be anticipated. The opposite assumption is made for the upper bound.

Overall Phase II and III lower budget ranges approximately equal the sum of lower values for individual Study Elements. The upper limits on overall Phase II and III budgets are approximately midway between the totals of the estimates for the individual Study Elements and the totals of the upper limits for the Study Elements. This is based on the assumption that it is improbable that maximal concern will develop over all impacts and issues at the same time that the maximum number of alternatives are retained. Even if this occurs, the upper limit on study budget will be applied to ration the allocation of funds.

The estimates for the Phase II and III allocations among Study Elements will be revised within the ranges shown as necessary, before the beginning of each of these later phases.

SECTION IV

CRITERIA

The functional relationship of criteria to the study process -- as a basis for the design and evaluation of program packages -- has been described in the preceding section of the report. The purpose of this section is to detail the preliminary list of criteria to be used, to describe how the list was derived, and to indicate how the criteria will be used in the design and evaluation process.

Development of the Criteria

The criteria have been developed from a series of value papers and position statements prepared by the participating groups and discussed and debated in the Working Committee. The main source for the listing is the Municipal Caucus Memorandum of 8/24/70, "Comments on the Restudy's Design and Evaluation Criteria and the Restudy Methodology". However, many other memoranda and papers provided significant contributions, and the most important of these are listed at the foot of the page. 1/

1/

"Comments on Preliminary Working Draft of Study Design (Criteria)" -- memo dated 9/30/70, from the Municipal Caucus.

"Comments on the Study Design Draft" -- memo dated 9/30/70 from the environmental coalition.

"Values" -- memo dated 7/1/70 from Nepon set Conversation Association.

"Regional Goals, Objectives and Policy Recommendations" -- memo dated 8/18/70 from MAPC.

"Transit Values" -- memo dated 8/18/70 from MBTA.

"Comments on the Restudy's Design and Evaluation Criteria and the Restudy Methodology" -- memo dated 8/24/70 from the Municipal Caucus.

"Initial set of GBC Values pertinent to the Transportation Restudy" -- memo dated 9/2/70 from GBC (Greater Boston Committee on the Transportation Crisis).

"Environmental Considerations for the Restudy" -- memo dated 9/2/70 from the Conservation Groups.

"Review and Comments on Study Proposal Draft (Criteria)" -- memo dated 9/30/70 from GBC.

The importance of the criteria, and the need for a comprehensive listing, as a method for making explicit the values of the participants, is emphasized in the introduction to the Municipal Caucus Memorandum:

> "We agree with the statement . . . that 'values' are manifested, in one way or another, in nearly every aspect of a transportation study. This memorandum is an attempt to make explicit our values as they appear, in particular in (the) design and evaluation criteria . . .
> Past transportation studies have often failed to allocate sufficient resources to conduct an adequate assessment of the socio-economic effects of proposed transportation facilities. We have a very strong interest in seeing that the current Restudy does not repeat this deficiency." 2/

Although the comprehensive list of criteria reflects the concerns and values of participants, the list is not final. Individual participants have expressed a desire to obtain additional inputs from private interests, municipalities and community groups through the course of the study.

Further changes may be required during the study as interaction with participants occurs, and as experience is gained with the process. Certain criteria may be dropped from further consideration if alternatives show no significant differences in particular dimensions. Other criteria may need to be added if new concerns arise or if the existing criteria do prove inadequate to reflect the range of values to be assessed.

Use of Criteria in the Design and Evaluation Process (see also Study Element 3)

During the pre-contract phase and the early part of Phase I, staff, working with study participants, will develop the actual measures to be applied to the criteria which will be used in this and succeeding phases of the evaluation. These measures will include common quantitative dimensions as well as categorical scales created for the assessment and comparison of qualitative dimensions.

In addition, during Phase I the staff will assist the Working Committee in developing standards for certain criteria. Such standards might include maximum or minimum values which cannot be violated (e.g., levels of air or noise pollution) or desirable

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2/ 8/24/70 -- See footnote 1.

values (e.g., land development patterns) to serve as design objectives.

It should be noted that the emphasis throughout the process will not be on assigning formal weights to the criteria, but rather on using them in the design of alternative program packages and the subsequent evaluation of alternatives.

A more detailed description of the work tasks involved in these procedures is set out in Study Element 3 in Part Two.

In Phase I, the evaluation procedures will be more general than those for later phases because of the use of short-cut methods and less detailed design definition. No criteria will be eliminated, but sets of closely related measures may be combined (e.g., general estimates of overall regional economic impact may be used instead of breakdowns by industrial category). Certain criteria may have to be treated qualitatively in Phase I whereas quantitative measures can be used in later phases. Wherever possible, however, estimates of quantitative measures will be provided and community perception of and evaluation of relevant criteria will be continuously sought throughout the process.

Synthesis of Criteria for Evaluation

The volume of information that will be produced for each alternative will be very considerable, and the staff will be required to develop procedures for synthesizing the material into comprehensible form.

The list of criteria includes diverse measures which include monetary values, quantitative non-monetary values, and qualitative assessments. Thus, it will not be possible to rely on a single overall criterion for evaluating and ranking alternatives. It is also recognized that the Working Committee is unlikely to be able to agree on relative weights to assign the various criteria.

Accordingly, the information will be synthesized and presented in a number of different formats, including, but not limited to:

1. A formal benefit-cost evaluation in which the differences among each pair of alternatives for which monetary values can be reasonably computed will be presented.

2. Summary measures and analyses of major types of impact. The measures will be partly quantitative and partly qualitative.

3. Summary comparisons of the impacts of the various alternatives on all major categories of socio-economic groups,

including qualitative evaluations and statements by affected private groups.

4. Visual portrayals of all designs at regional and corridor scales. Joint development designs and transportation facilities will be described by architectural sketches and preliminary designs.

Preliminary Listing of Criteria to be Used in the Design and Evaluation Process

In summary, three general considerations apply to all of the criteria listed in the following pages.

First, all criteria are subject to refinement and modification throughout the process, as desirable standards for each criterion come to be better defined, and as the study process measures the performance of the alternatives against the criteria. The accompanying table indicates the relationship of criteria to Study Elements.(Figure IV.1)

Second, the criteria are intended to be applied to program packages as a whole, not just to the elements making up the program packages.

Third, the criteria should be seen as providing the basis for both design and evaluation of the program packages.

In addition, it is recognized that a desire to emphasize the concept of equity -- i.e., the full restoration of those affected to at least their previous position -- underlies this listing of criteria.

1. ECONOMY

The introduction to the Municipal Caucus Memorandum of 8/24/70 clearly sets out the values underlying the items listed under this category.

> "One emphasis . . . is the principle of defining the scope and costs of a transportation proposal broadly enough to allow those affected to have their situations effectively restored. That is, the full extent of any unavoidable loss or damage (e.g., a lost or damaged school, playground, house or business) should properly be totally restored. Only if this procedure is followed will the true costs of proposed transportation facilities be accurately assessed and included as project costs in the course of planning decisions as well as implementation. For too long, local and state taxes (or uncompensated individual citizens) have had to pick up the

Figure IV.1

PRIMARY RELATIONSHIP OF CRITERIA TO STUDY ELEMENTS

Criteria	Study Element
1. ECONOMY	
A. Costs of Highway, Transit & Traffic Engineering Improvements	
(1) Property Costs	SE#12 Replacement Housing etc.; SE#13 Business Relocation etc.; SE#5 Joint Development; SE #10 Environmental Studies
(2) Construction Costs	SE#4 Transportation System Design
(3) Auxilliary Facilities	SE#5 Joint Development etc.
(4) Replacement Facilities	SE#5 Joint Development etc.; SE#12 Replacement Housing; SE#13 Business Relocation ; SE#10 Environmental Studies
(5) Moving Expenses	SE#12 Replacement Housing etc.; SE#13 Business Relocation
(6) Business Relocation	SE#13 Business Relocation & Employment
(7) Construction for Non-Relocated Property	SE#5 Joint Development etc.
(8) Loss of Value	SE#5 Joint Development; SE#10 Environmental Studies
(9) Change in Tax Base	SE#5 Joint Development; SE#13 Business Relocation etc.
(10) Cost of Compensation During Construction	SE#12 Replacement Housing etc.; SE#13 Business Relocation etc.
(11) Operating Costs of Cities and Towns	SE#5 Joint Development etc.
(12) Changes in Rent Levels	SE#12 Replacement Housing etc.; SE#13 Business Relocation
(13) Continuing Services	SE#5 Joint Development etc.; SE#11 Regional Economy
(14) Relocation Programs	SE#12 Replacement Housing etc.; SE#13 Business Relocation; SE #10 Environmental Studies
(15) a. Costs on Public Agencies b. Costs on Public Groups	SE#6 Land Use & Travel Forecasting
(16) Capital Costs for New Equipment	SE#4 Transportation System Design
(17) Capital Costs of Additional Private Vehicles	SE#4 Transportation System Design
(18) Aggregate Costs vs. Available Resources	SE#11 Regional Economy
B. Operating Costs	
(1) Net Change in Car/Truck Operating Costs	SE#6 Land Use & Travel Forecasting
(2) Net Change in Transit Operating Costs	SE#6 Land Use & Travel Forecasting
C. Total Costs	
(1) Net Change in Total Operating Costs	SE#4 Transportation System Design; SE#6 Land Use & Travel Forecasting
2. TRANSPORTATION SERVICE	
A. Net Change in Travel Times	SE#6 Land Use and Travel Forecasting
B. (1) Frequency of Service, etc. -- Peak Hour	SE#4 Transportation System Design
(2) Frequency of Service, etc. -- Non-Peak Hour	SE#4 Transportation System Design
C. Access to Employment, etc.	SE#6 Land Use & Travel Forecasting; SE#7 Special Mobility Studies
D. Reliability	SE#6 Land Use & Travel Forecasting; SE#7 Special Mobility Studies
E. Convenience, etc., to User	SE#4 Transportation System Design
F. Waiting Times, etc.	SE#6 Land Use & Travel Forecasting
G. Integration and Coordination	SE#4 Transportation System Design
H. Clarity and Informativeness	SE#4 Transportation System Design
I. Ease of Boarding	SE#4 Transportation System Design
J. Net Change in Travel Times to Non-Users	SE#5 Joint Development etc.; SE#4 Transportation System Design
K. Privacy	SE#4 Transportation System Design
L. Change in Travel Time During Construction	SE#11 Regional Economy; SE#6 Land Use & Travel
M. Service to Unmet Transportation Needs	SE#7 Special Mobility Studies
N. Ease and Convenience of Handling Packages	SE#4 Transportation System Design
O. Convenience for Goods Movement	SE#4 Transportation System Design
P. Effects on Local Street System	SE#4 Transportation System Design
3. SAFETY	
A. Changes in Injuries, etc.	SE#6 Land Use & Travel Forecasting
B. Property Damage	SE#6 Land Use & Travel Forecasting
C. Protection During Demolition	SE#5 Joint Development; SE#14 Neighborhood Cohesion
D. Safety During Construction	SE#5 Joint Development; SE#14 Neighborhood Cohesion
E. Convenience During Construction	SE#4 Transportation System Design; SE#5 Joint Development
F. Meteorological Effects on User Safety	SE#4 Transportation System Design
4. COMMUNITY QUALITY	
A. Noise Levels	SE #10 Environmental Studies
B. Air Pollution	SE #10 Environmental Studies
C. Visual, Psyschologial Barrier	SE #10 Environmental Studies
D. Neighborhood Disruption (1-4) **	SE #10 Environmental Studies
E. Social and Cultural Impacts (1-8)	SE#11 Regional Economy; SE#12 Replacement Housing; SE#13 Business Relocation; SE#14 Neighborhood Cohesion
F. Development Opportunities (1-3)	SE#5 Joint Development
G. Effect on Community Strength & Growth (1-3)	SE#5 Joint Development
H. Visual Characteristics (1-6)	SE#5 Joint Development; SE#10 Environmental & Conservation Studies
I. Effects on Natural Features (1-6)	SE#10 Environmental & Conservation Studies
5. ACCEPTIBILITY AND ADAPTABILITY	
A. Coordination	SE#4 Transportation System Design
B. Adaptability to Social/Environmental Programs	SE#5 Joint Development;SE#10 Environmental Studies
C. New Technology	SE#8 Technological Planning
D. Changing Travel Desires	SE#6 Land Use & Travel Forecasting
E. Future Options & Irreversible Change	SE#4 Transportation System Design; SE#7 Special Mobility Studies; SE#6 Land Use & Travel Forecasting
F. Feasibility of Implementation (1-3)	SE#9 Administrative & Legislative Studies
6. DISTRIBUTIONAL EFFECTS	
A. Effect on Selected Groups (1-6)	SE#10 Environmental Studies; SE#12 Replacement Housing; SE#11 Regional Economy
B. Land Use Distributional Effects (1-2)	SE#5 Joint Development; SE#6 Land Use & Travel Forecasting ; SE #10 Environmental Studies
7. SHORT AND LONG TERM EFFECTS ON THE REGIONAL ECONOMY	
A. Positive or Negative Impacts on Federal Aid Funds	SE#11 Regional Economy
B. Positive or Negative Impacts on Alternative Program Packages	SE#11 Regional Economy; SE#10 Environmental Studies

* This table identifies primary responsibility for the generation of data & the measurement of performance, etc. There will be many areas of overlap & a clear need for continuous coordination. A major coordination role will be performed in Study Element 5 - Joint Development & the Development of Alternative Program Packages.

** Numbers in parentheses indicate sub-criteria, omitted here for simplicity.

additional costs not properly borne by transportation agencies."

In general, these criteria are susceptible to quantification in monetary values:

A. Costs of Highway, Transit and Traffic Engineering Improvements

1. Property costs (public and private), based on paying owners full values for an equivalent replacement property.

2. Standard construction cost items, including but not limited to demolition, earth moving, grading, laying track, paving, signalization, lighting, drainage and necessary and related flood control, landscaping, structures, and all associated design work.

3. Net cost (plus or minus) of constructing auxiliary facilities such as parking facilities which are necessitated as a direct result of the change in transportation facilities.

4. Full replacement cost of all public services and facilities removed (e.g., schools, libraries, parks, ponds, playgrounds, open space, firehouses, police stations, parking lots, etc.), based on replacing the disrupted activity.

5. Full moving expenses of residents, businesses, and institutions, including those reimbursable under existing statutes and governmental programs as well as additional costs actually incurred but not reimbursed (e.g., loss of non-transferrable household and other items; cost of disconnecting and reinstalling machinery, equipment, household appliances, etc.) with cost estimates based on available studies of previous relocation operations, including those in the Boston area.

6. Business relocation gains/losses and failures, including gain or loss of net operating revenues, as estimated from available statistical studies.

7. Estimated costs of construction required for non-relocated properties to correct the effects of noise, pollution, and vibration resulting from

the change in transportation facilities; based on available studies and data.

8. Net change in monetary value (plus or minus) of non-relocated properties affected by uncorrectable changes in noise, pollution, and vibration associated with the change in transportation facilities; estimates based on available studies and data.

9. Net change (plus or minus) in real estate taxes based on losses from those properties taken for use as transportation facilities and any gains (or losses) in taxes resulting from changed valuations of non-relocated properties and from joint development or other construction stimulated by the facilities.

10. Estimated costs during construction period to non-relocated neighborhood businesses, institutions, and residences.

    (a) due to lost income

    (b) for repair of damage and/or required special construction related to noise, pollution, and vibrations, from diverted traffic and construction vehicles.

11. Estimated net change in operating costs of particular cities and towns and of the metropolitan region, resulting from the change in transportation facilities and including police and fire protection, schools, trash removal, etc.

12. Aggregate amount of increased or decreased rent levels, or mortgage payments, based on calculating the total amount of subsidies required to construct replacement housing at rents or mortgage payments equal to those of the housing units and business space demolished by the changed transportation facilities; costs computed over the life expectancy of the transportation facility.

13. Estimated costs of additional continuing services needed by those displaced, based on their age, vocational skills, changed proximity to kin, etc., including psychiatric and medical care, welfare, delinquency, etc.; estimates based on available studies of past relocation operations.

14. Costs of relocation and replacement programs to the transportation agency.

15. Incidence of costs on:

    (a) the responsible public agencies

    (b) groups within the public, through the source of payment (property taxes, gasoline taxes, and so forth).

16. Capital costs for new equipment (vehicles, traffic signals, operation control centers).

17. Capital costs of additional private vehicles to compensate for any reduction in level of service.

18. Aggregated transportation costs (capital, maintenance and operating costs) and resultant non-transportation costs (relocation, replacement, etc.) should be compared with the budgetary capabilities of the relevant state or municipal jurisdictions.

B. Operating Costs

1. Net change in total operating costs for all cars and trucks due to the changes in facilities. This category would include any changes in operating cost of one mode due to changes in another mode.

2. Net change in total operating costs for all types of transit vehicles and systems due to the changed transportation facilities.

C. Total Costs

1. Net change in total operating, maintenance, and capital costs, by each system type, for the entire package of changed transportation facilities.

2. TRANSPORTATION SERVICE

In addition to the conventional concern with reducing overall travel times and improving accessibility between residential and employment concentrations, considerable attention is directed to the level of service provided by each alternative to specific groups of users with particular reference to minority groups with

special problems (e.g., disabled, young, and non-car owners). The GBC memorandum of 9/2/70 summarized this concern:

> "In general it (a transportation proposal) should provide maximum mobility and accessibility to those communities . . . that have sizable latent and/or inadequately serviced transportation needs."

Quality of service is also explicitly noted as a measure of performance:

> "This means providing quality access (in terms of time, convenience and cost) to jobs, public and private services and facilities (schools and hospitals, etc.), shopping areas, social contacts (visits), etc."

The Transportation Service criteria are as follows:

A. Net changes in travel times (plus or minus) for various user groups, due to the changed facilities. Different types of user groups would include, but not be limited to: car owners, non-car owners, the elderly, the young, the poor, the disabled, and residents and businesses of particular areas.

B. Frequency of service, travel times, and price of service to the users.

   1. Peak hour service levels, times, and costs.

   2. Non-peak hour service levels, times and costs.

C. Access provided to employment, educational, commercial, medical, cultural, social and other public and private facilities, services and amenities.

D. Reliability of reaching destination within time preferred (includes dependability of equipment, of flow, etc.), aesthetics, effects of congestion.

E. Convenience, comfort, aesthetics, effects of congestion, and other qualitative aspects from the point of view of the user.

F. Waiting time, walking time, walking distance, and transfers required.

G. Integration and coordination between the various service elements.

H. Clarity of the transportation pattern, informativeness, variety, and stimulation provided to the user.

I. Ease of boarding and deboarding, especially for the elderly, the disabled, and the young.

J. Net change in travel times, plus or minus, and accessibilities for non-users of the facility, including but not limited to pedestrians, users of cross facilities, and those impacted by congestion induced on related facilities.

K. Privacy or participation.

L. Changes in travel times and accessibilities during the construction period.

M. Service provided for previously unmet or latent transportation needs, recognizing that "demand" for transportation is a function of the transportation service available.

N. Ease and convenience of handling packages.

O. Convenience for goods movement.

P. Effects of line haul facilities, e.g., expressways and rapid transit, on arterial and local street systems.

3. SAFETY

In addition to the conventional measures of the effect of transportation improvements on the users, and the effect of damage to adjacent property, additional criteria have been included to take account of problems of personal safety during the demolition and construction periods:

A. Changes in probable numbers of injuries and fatalities, to vehicle occupants and pedestrians, due to new transportation facilities, based on records of the DPW, transit agencies, the Massachusetts Registry of Motor Vehicles, and insurance companies in the region.

B. Changes in probable amounts of property damage for the changed transportation facility, based also on the above sources.

C. Costs of minimizing disturbance and providing extra

protection during the demolition and construction phase of implementation.

D. Safety during time of construction to nearby residents and businesses and users of facilities affected by the construction process.

E. Protection from discomfort and inconvenience during the construction of transportation facilities.

F. Consideration of meteorological effects on user safety, such as incidence of fog, icing, cross winds and so forth.

4. COMMUNITY QUALITY

Grouped under this heading are a wide variety of criteria relating to environmental quality, conservation goals and the measurement of impacts on the socio-economic structure of neighborhoods, and larger communities.

The goals and values implicit in this list are too numerous to detail. The most important might be summarized from the GBC memorandum quoted previously.

. . . "Transportation packages are to be designed with the improvement, maintenance and protection of the social, economic and physical environment of a community as the primary goal.

. . . Every effort must be made to eliminate or minimize social, economic and environmental impacts. Maximum or minimum allowable levels need to be defined for such impacts as:

1. Air, noise and water pollution
2. Traffic congestion
3. Residential density
4. Glare, vibration, heat, fumes, odors
5. Pedestrian safety and linkages
6. Parks, recreation and green space
7. Time, cost and convenience of transportation service (and many others).

. . . Community stability and cohesion must be maintained and enhanced at all stages of transportation development and operation.

. . . Replacement facilities and services must be

available within the community or at an acceptable location before any demolition or disruption is allowable.

. . . The development of non-transportation facilities resulting from the development of transportation facilities must be coordinated and consistent with the land use needs of the community. Land use and zoning controls must be available that insure development that is acceptable and compatible with community needs.

. . . Unique natural features, natural resources, parks, areas of historical and architectural significance should be preserved and protected." 3/

In the main, the items listed below, and those in the remaining subsections are qualitative measures. Each item will be examined to the point where it can be determined whether or not a specifiable qualitative effect would result in the case of the particular alternative.

In cases where such effects are formed, the nature of the effect will be systematically described within the limits of known predictability. In every case it will be necessary to exercise judgment concerning the feasibility of assessing and describing the qualitative effects.

The community quality criteria are as follows:

A. Noise levels, with attention to the degree to which the types of surrounding activities are affected by special design features (grade and buffering).

B. Impacts of fumes and ambient air pollution levels with weight given to the extent of human occupancy of affected activities.

C. Positive or negative impacts of the transportation facility as a physical, visual, or psychological barrier.

D. Positive or negative neighborhood impacts due to rerouting vehicles (transportation service changes for users are already covered).

3/ 9/2/70 -- See footnote 1.

1. Effects on local businesses and business opportunities.

2. Effects on fire and police protection.

3. Effects on abutting residences.

4. Effects on other abutting facilities.

E. Effects on Social and Cultural Conditions.

1. Positive or negative impacts on neighborhood cohesion, stability, identity, resiliency (for example, integrating or splitting of church parishes).

2. Effects on areas of historical or architectural interest.

3. Effects on vital parts or special elements of a city or community.

4. Potential to develop symbolic or other assets.

5. Adequacy of relocation program and the feasibility of timely staging of the replacement program to precede demolition.

6. Social effects on non-relocated persons, including possible loss of relationships, increased or decreased safety during construction, etc.

7. Positive or negative effects on ongoing or planned social programs (for example, redevelopment, model cities, school construction, etc.).

8. Positive or negative psychological impacts on individuals affected by changed social and cultural activities.

F. Development opportunities created by the transportation program package.

1. Positive or negative effects of expected land utilization, in relation to local and regional development goals.

2. Potential for future joint development (when such joint development is not in the present program package itself).

3. Viability of remnants of former land users.

G. Effects on general community strength and growth.

1. Effects on educational system.

2. Effects on recreational facilities (indoor and outdoor).

3. Effects on welfare.

H. Visual characteristics.

1. Appearance of the facility from the environs.

2. Positive or negative effects as a visual barrier.

3. Scale of the facility and visual balance between it and surroundings.

4. Visual character of facilities for vehicle passengers or drivers.

5. Effects of glare and other extraneous light.

6. Effects on litter.

I. Effects on natural features.

1. Effects on public and private open space and unique natural features.

2. Effects on park land and foliage.

3. Effects on lakes, streams, and ground water.

4. Effects on flood plains.

5. Effects on erosion patterns.

6. Effects on wildlife habitat.

J. Effects on power consumption and heat generated.

5. ACCEPTABILITY AND ADAPTABILITY

The following criteria are included to measure, in broad policy terms, the acceptability of alternatives to both present and future situations, and the adaptability of the program packages to future possibilities. The program packages themselves will be

developed to have all elements within them consistent.

A. Possibilities for timely coordination with other transportation systems, such as intercity transport.

B. Adaptability and compatibility to present and proposed social and environmental programs.

C. Adaptability to new technologies.

D. Adaptability to changing travel desires and changing travel needs.

E. Effects on leaving open or closing future options and causing or not causing irreversible change.

F. Ease and feasibility of implementation for both immediate and longer term parts of the program packages.

1. Acceptability to Federal, State and Local Governments.

2. Acceptability to affected private organizations and community groups.

3. Statutory, legal and administrative changes necessary for implementation.

G. Relationship of both transport related and transportation impact costs to the budgeting capabilities of state and local jurisdictions.

6. DISTRIBUTIONAL EFFECTS

Analysis of the distribution of impacts can provide additional information for the evaluation of alternative program packages. It can suggest changes in program packages such that the generalized criterion of equity is served.

A. For each criterion in the preceding sections, show the impacts of each alternative on the various types of groups. Groupings of persons should be chosen as much as possible to highlight differences in impact, not to smooth out differences by averaging or totaling each impact. In particular, "groupings" might include, but not be limited to:

1. Relocated businesses, residences and land users.

2. Adjacent businesses, residences and land users.

3. Various neighborhoods and municipalities served and impacted in other ways by the new facilities.

4. Persons with cars available and persons with no cars available.

5. Minority groups, such as racial or ethnic minorities, the elderly, the young, the handicapped, and the poor.

6. "Heavy" users of the alternatives as opposed to "light" users.

B. Land Use Distributional Effects.

1. Positive or negative effects of land use or density changes on parcels of land abutting or nearly adjacent to the transportation facilities, when compared with the general or specific land use goals of the area. There should be a consistency of proposed joint development features and future development possibilities with those goals.

2. Positive or negative impacts of alternatives on the regional distribution of land use activities, residences and employment by type and density, including the regional distribution of open space and its utilization. Impacts will be compared with regional and local land use distribution goals and policies.

SECTION V

ALTERNATIVES

The final selection and refinement of the alternative program packages for the first phase evaluation will be a primary task during the early months of the study.

During the study design process a wide range of alternatives has been described and reviewed by the Working Committee and the Steering Group. 1/ The process of review and redefinition has

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1/

"Very Preliminary Listing of Alternatives" -- memo dated 8/18/70 from Mr. Stowers, SDC.
"Initial Comments on Stowers' 8/18/70 Memo on Program Package Alternatives" -- memo dated 8/24/70 from Municipal Caucus.
"Comments on Stowers' August 18, 1970 Memo" -- memo dated 8/24/70 from Mr. Graham, MBTA.
"Comments on Stowers' August 18, 1970 Memo, 'Suggested Alternatives'" -- memo dated 8/25/70 from the Metropolitan District Commission.
"Consultant Memorandum dated August 17, 1970"-- memo dated 8/25/70 from Mr. McBride, MAPC.
"Summary Comparison of Alternative Program Packages" -- memo dated 9/1/70 from Mr. Stowers, SDC.
"Round Two on Alternatives" -- memo dated 9/1/70 from Mr. Stowers, SDC.
"Response to Stowers' Round Two Memo of September 1, 1970" -- memo dated 9/2/70 , from Mr. Graham, MBTA.
"Detailed Comments on Stowers' Memo" -- memo dated 9/9/70 from the Municipal Caucus.
"Review of Preliminary Work Draft for Boston Transportation Study Design (General Comment; Sections III, V-1)" -- memo dated 9/25/70 from the Municipal Caucus.
"Definition of Coverage Intensive Transit" -- memo dated 9/30/70 from Mr. Graham, MBTA.
"Alternative Possibilities for Southwest Corridor" -- memo dated 10/7/70 from Mr. Turner, GBC.
"Part I: of Revised Study Design" -- memo dated 10/20/70 from Mr. McBride, MAPC.
"Harvard Alewife Expressway Extension" -- memo dated 10/20/70 from Conservation Groups.

gone through two iterations and the alternatives outlined in the following pages represent a significant reduction in the original number generated. This process of reduction and elimination is expected to continue through Phase I of the study process.

The alternatives are grouped under three major themes, or sets of design objectives that have emerged from the dialogue carried on within the study design process. It is important that they are not seen as auto vs. transit, but rather as mixtures of different elements emphasizing different design philosophies or "themes".

The "themes" of each alternative are at present described by combinations of a number of generalized goals, e.g., (a) provide mobility for core area non-drivers, (b) provide highway mobility for suburban to CBD links, (c) stress minimal disruption to core area communities, (d) provide suburban to CBD transit mobility, (e) stress design to alleviate damaging impacts, or (f) provide for lateral or circumferential highway mobility.

It should be emphasized that the sets of alternatives encompasses not only new proposals but also a wide range of existing planned and approved projects. This arrangement will facilitate one of the central goals of the study process -- staged decision making. Thus, certain proposals will be eliminated as the study progresses and at the same time, expressway, arterial, and transit elements that are common to all networks can be identified, approved and released for design and construction.

In addition to the description of the specific alternatives for examination, this section also outlines the general scope of both transportation elements and transportation impact elements to be included in program packages.

It should be noted that these functional designations -- e.g., "transportation" and "transportation impact" elements -- are used to describe components of any single program package, thus the designation "transportation impact" is used to describe certain physical facilities or services and does not imply separation of the elements or a difference in priority.

Transportation Impact Elements of all Program Packages

Each defined program package will contain a set of elements whose implementation will be tied inextricably to the implementation of the transportation elements. These elements will be designed to:

1. Integrate the transportation facility with the needs

of, and maintain the integrity of, affected communities.

2. Ensure that the transportation proposals are consistent with comprehensive regional planning goals and with local objectives and development priorities.

3. Offset the negative impacts of transportation facilities.

4. Capitalize on realistic opportunities to attract private development of the type most desired from each affected community's perspective.

5. Take advantage of opportunities which may be provided by the introduction of transportation improvements to help solve pre-existing problems identified by the communities.

A minimum standard will be that transportation program funds will be expected to assume responsibility for elements in (3) above. An objective in the design of these program elements will be to seek maximum feasible assistance from transportation programs in all of the above types of actions. In addition to work on the design of transportation impact elements of program packages, specific study activities will be devoted to (a) devising means of assuring joint implementation of transportation impact elements; (b) supporting community initiative in identifying problems, priorities and needs, and contributing toward the design of transportation impact elements; and (c) devising legislative and other mechanisms for expanding the capacity of transportation programs to assure and contribute to the implementation of program elements selected during this study.

Transportation impact program elements will vary among communities and among alternatives. As a minimum they will include:

1. The provision of replacement housing to fully accommodate all families displaced.

2. The staging of construction to accommodate the needs of families, businesses and institutions which have relocation problems.

3. A substantially improved relocation assistance program to fully achieve the objectives of the 1968 Federal Highway Act for all transportation actions.

4. Replacement or renovation of all recreational facilities, schools and other public facilities to be taken or harmed.

5. Air rights and other joint development efforts to achieve private development sufficient to at least equal each municipality's tax base for the null (no highway) alternative.

6. Intensive design efforts to improve upon, or at least equal, existing conditions regarding the convenience and safety of pedestrian linkages and local vehicle circulation, the cohesiveness of residential neighborhoods, and the viability of retail-service centers.

Elements may include the provision or improvement of social and community services as well as physical facilities. Specific elements to be included cannot be identified accurately until completion of the relevant study activities, although it is known that substantial housing and joint development efforts will be required for alternatives involving new expressways in high density areas to achieve the objectives and standards specified above. Existing needs for social service elements will be identified for inclusion in the evaluation of particular alternatives. The improvements attained in social and community services will be listed in addition to the physical improvements attained.

Consistent with the establishment of minimum levels of service or performance for transportation components, minimum standards will also be set for the design and implementation of transportation impact elements of program packages. For example, procedures will be established to insure that replacement or relocation facilities are in place before the demolition of existing property.

Transportation Elements of the Program Packages

Some transportation elements are common to all the program packages. Every program package includes highway improvement and transit improvements. Variations in the alternative program packages occur in their emphasis on particular goals, including both transportation service goals and the related consequences. For example, arterial improvements are of some priority in every program package alternative. The emphasis on particular types or purposes of arterial improvements varies over program packages. Some arterial improvement programs may emphasize serving travel oriented towards the core; others may emphasize taking through traffic off residential streets, or providing special improvements for transit vehicles. An important point regarding the description of elements of program packages is that not all require the same total expenditure of resources. Within any

given level of expenditures there is some tradeoff between providing different services and amenities. The description of the emphasis within each program package deals with the relative expenditures in that program package, not with the total expenditures. One program package may have "heavy emphasis" on transit service of a particular sort, while another program package, with higher total resources, may provide the same absolute level of that particular transit service, yet have an "equal emphasis" on something else.

Transportation System Elements will include:

1. Expressways
2. Parking capacity and availability
3. Arterial streets
4. Operational measures
5. Transit
   (a) Line haul elements
   (b) Intensive coverage systems
6. "Mode Mixers" (transfer points)
7. Demonstration projects

In addition special attention will be given, where appropriate, to the interface between metropolitan and inter-regional transportation systems, such as the airport and possible high speed ground links.

ALTERNATIVE A

Design Goal and Theme

This alternative stresses highway mobility, particularly improvements in radial travel with full compensation for disruption through sensitive design and through the transportation impact elements of this program package. Some stress is also put on transit improvements, although it is recognized that demand for transit may be less than in other alternatives. This alternative is the most detailed in its present description of transportation elements, since it draws heavily upon existing and committed projects.

1. Expressways

This alternative involves the greatest expressway construction. The expressways are basically the system described in the Eastern Massachusetts Regional Planning Project Summary Report "Recommended Highway and Transit Plan" 1968. Since sub-options exist for the relocation and detailed design of some of these expressways, they are indicated in terms of their corridors.

Expressway Recommendations from the EMRPP Report

The following is a brief listing of the recommendations from the EMRPP report (pp. 5-7) for expressways within Route 128. The very general estimates of the years for completion of projects have been updated since the 1968 report. The staging of projects depends, of course, on decisions yet to be made.

1) Projects under construction or recently completed (1970)

. . . I-93 from Medford to Somerville (under construction)

. . . Route 2 from Route 128 in Lexington to Alewife Brook Parkway, Cambridge (recently completed)

2) Short Range Program (Approximately 1970-1980)

. . . Construct I-95 North from Danvers to Revere (a portion in Revere is under construction)

. . . Construct a Revere Beach Connector

. . . Construct a Beverly Salem Connector

. . . Upgrade the existing I-95 from Revere to Chelsea

. . . Construct I-95 from Canton to the Inner Belt in Roxbury (Southwest Expressway)

. . . Construct the Inner Belt

. . . Continue I-95 from the Southwest Expressway/ Inner Belt Interchange to the Central Artery

. . . Improve the Central Artery

3) Long Range Program (After 1980)

. . . Construct a New Harbor Crossing

. . . Construct approaches to a New Harbor Crossing

. . . Construct a Shore Expressway from the New Harbor Crossing to I-95 in Saugus

. . . Construct a new Route 2 from Alewife Brook Parkway to Somerville at the Inner Belt

. . . Provide additional capacity on the Southeast Expressway from Braintree to Boston

Expressway Sub-Options Defined by the Working Committee

There are several variations within this alternative which are sub-options to the EMRPP Plan. It should be recognized that others may be generated during the study process. The presently defined range is as follows:

1) EMRPP network with no Harbor Crossing and a subset alternative substituting the Western Corridor circumferential for the Inner Belt.

2) EMRPP network including the Harbor Crossing with the Western Corridor circumferential substituted for the Inner Belt.

3) EMRPP network with no Inner Belt or Western Corridor circumferential and

   a) a study for the termination of Route 2 at Dewey and Almy Circle (with particular attention to the effect on local arterials, especially Alewife Brook Parkway and Fresh Pond Parkway).

   b) a study for an alternative bringing Route 2 into the vicinity of Sullivan Square and making a connection with I-93/I-695.

4) All network tests to include

   a) a subset study for the presence or absence of the South End By-Pass.

   b) a subset study for the effect of making the Third Harbor Crossing a toll or a free facility.

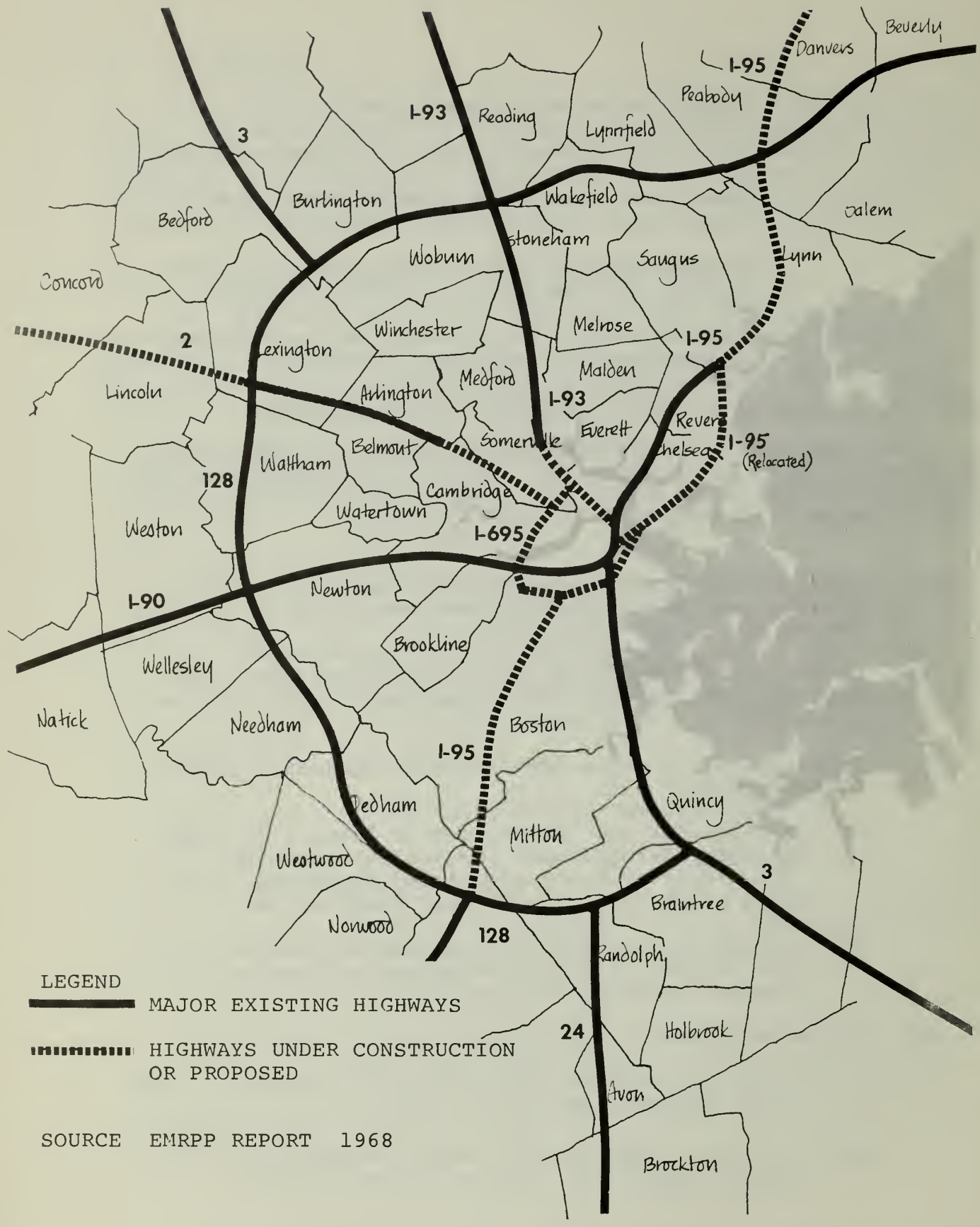

Figure V.1 RECOMMENDED HIGHWAY PLAN (EMRPP 1968)

2. Parking

Alternative A is likely to lead to the largest demand for downtown parking. (The assumptions of the Task A study in regard to parking would be carefully reviewed as a sub-study of this and other alternatives.) Increases in all-day downtown parking rates might be assumed necessary to prevent saturation of core local streets and parking capacity.

3. Arterials

Arterial improvements would be oriented towards removing traffic from local streets where feasible, towards providing access to the expressways or providing mobility in those directions not served so directly by the expressway system, such as lateral movements.

4. Operational Measures

Under this alternative, they might be oriented more towards the alleviation of local congestion. Some improvements to improve the flow of transit vehicles might be made as in other alternatives. There would also be measures to move vehicles smoothly onto and off of the expressways if analysis shows this to be a desirable modification to improve the operation of expressways. Consistent assumptions about possible operational improvements on feeder streets will be made in judging between any expressway sub-options within this or other alternatives.

In this and all other alternatives, TOPICS work and analysis will benefit from coordination with a major statewide TOPICS needs study.

In this and all other alternatives tested, specific techniques for improving the operation of existing and proposed freeways will be studied, e.g.,

(i) metering ramps to maintain smooth flow and increased volume on expressways (and parkways).

(ii) Special expressway lanes for use of buses or transit vehicles.

5. Transit

Major sub-options under transit in Alternative A consist of

the relative degree of emphasis on transit extensions vs. intensive "coverage" in the inner areas and other operations improvements.

In general, transit is of more relative emphasis in the other alternatives. Transit possibilities for both extensions and coverage service are described here for clarity, however.

The choice of relative emphasis on either transit extensions into suburban areas or transit coverage improvements exists for all alternatives and all levels of total expenditure. To some extent that choice may depend on the relative emphasis of highway investments in serving particular movements. For instance, if highway investments improve mobility towards the core for both auto and transit vehicles, transit investment might be oriented more toward serving lateral trips, or vice versa.

Some specificity already exists on particular proposals for transit extensions. Coverage intensive transit improvements are less well detailed at this time and are likely to require fine grained analysis during the study period in order to reach specificity.

Each transit "extension" itself will involve a sub-study as to hardware (rail, bus lanes on freeways, busways, dual propulsion vehicles, etc.) and analysis of its patronage in relation to other possible investments.

Transit Extension Options

A range of possible transit extensions is listed below from the EMRPP report, "Recommended Highway and Transit Plan". Many sub-options exist, but it is clear that as far as line haul extensions are concerned they will build upon the EMRPP recommendations. It is important to note that this listing should not be interpreted to represent official MBTA policy at this date. They are previous suggestions. The following are taken from the EMRPP Report.

"1) Committed Projects (1968)

a) Extend Orange Line Rapid Transit from Haymarket Station to Oak Grove (Malden-Melrose)

b) Eliminate the North Station-to-Everett elevated structure

c) Extend the Red Line Transit from Harvard Square to Alewife Brook Parkway

d) Relocate the existing Orange Line Rapid Transit from Back Bay to Forest Hills and extend the line to the VFW Parkway in West Roxbury

e) Extend the Red Line rapid transit from Andrew Station to South Braintree

2) Short-Range Program (1968-1975)

a) Extend the Blue Line Rapid Transit from Wonderland Station to Pines River

b) Extend Orange Line Rapid Transit from the VFW Parkway to Route 128 in Canton

3) Long-Range Program (1975-1990)

a) Extend the Blue Line Rapid Transit from Pines River to Salem

b) Construct a branch from the Blue Line Rapid Transit to Logan Airport

c) Extend the Orange Line Rapid Transit from Oak Grove to Route 128 in Wakefield

d) Extend the Red Line Rapid Transit from Alewife Brook Parkway to Route 128 in Lexington

e) Upgrade the Riverside Line to high platform rapid transit

f) Extend the Riverside Line Rapid Transit from Riverside Station to a new Middle Circumferential Expressway near the Wellesley-Natick line

g) Extend the Red Line Rapid Transit from South Braintree to South Weymouth

h) Connect the Riverside Line with the East Boston Blue Line." 2/

Of these 1)a), 1)b) and 1)e) are presently under construction. The extension of the Red Line, 1)c), is the subject of negotiations between the City of Cambridge and the MBTA, and most of the other projects are the subject of an extensive staff study and review.

2/ EMRPP, Recommended Highway and Transit Plan, 1968, pp. 5-7.

SPECIAL DESIGNATIONS:

Ⓐ -- SOUTH SHORE EXTENSION
Ⓑ -- HARVARD-ALEWIFE
Ⓒ -- SOUTHWEST TRANSIT EXT.

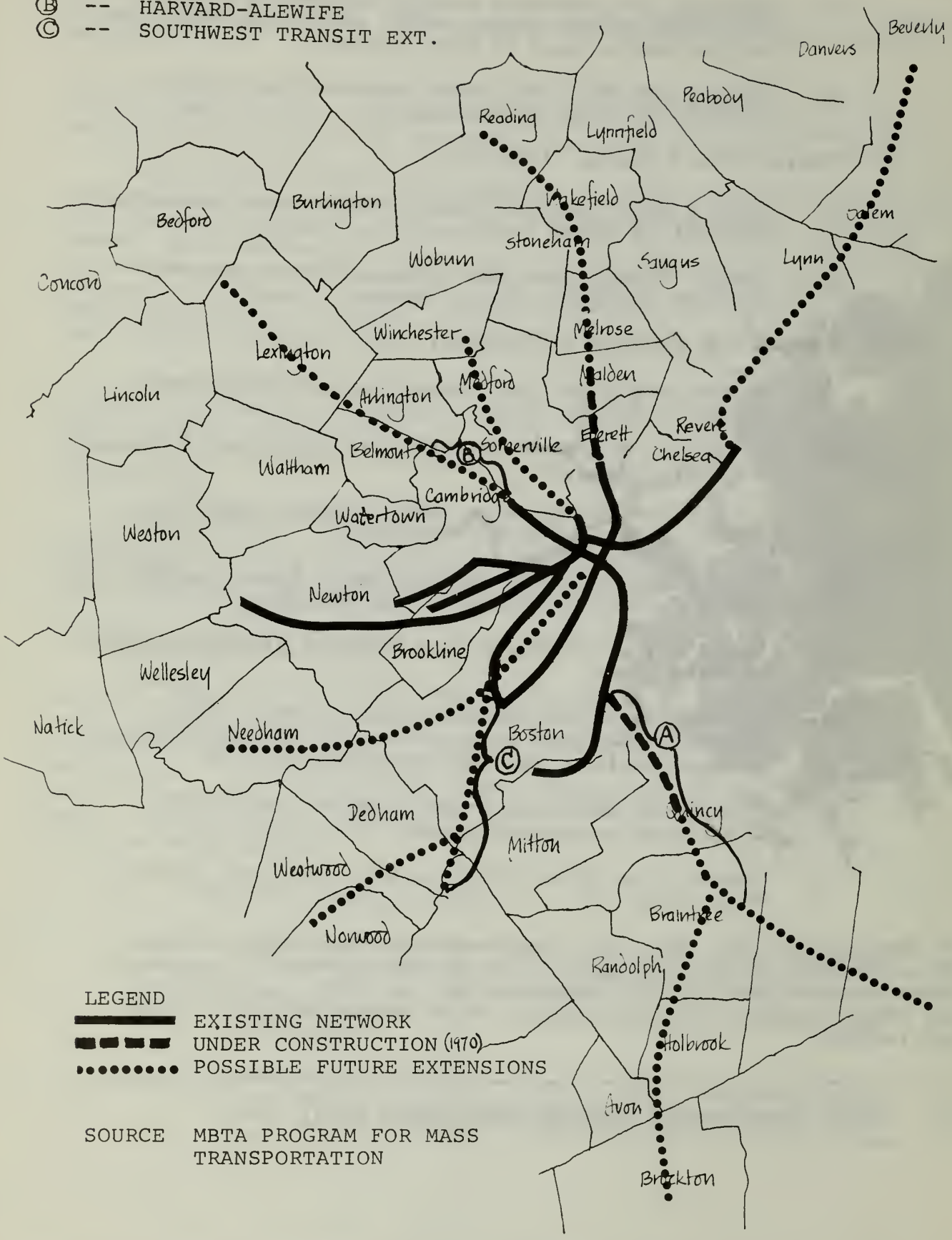

Figure V.2 RECOMMENDED TRANSIT PLAN (EMRPP 1968)

Major Transit Sub-Options Defined by the Working Committee

Sub-options for transit extensions will include:

1) Bus lanes or buses on freeways or busways, including some emphasis on transfer facilities and integration of service.

2) Dual propulsion transit vehicles which operate on rails or highways; or other new types of systems.

3) A subset study of the impacts of continuation or discontinuation of the various commuter rail lines serving the Boston area, with consideration also of effects of possible improvements to those services.

Transit Coverage Improvements

All sub-options listed under Alternative A include a subset study of coverage intensive transit service improvements for the inner areas of the region. Transit coverage is described more fully in Alternative B but includes considerations for improving the use of existing facilities and new service through either traditional or innovative systems.

6. Mode Mixers

Mode-mixers are new types of transfer facilities whose concept is outlined more fully in Alternative C. In this alternative they might be more like conventional transfer facilities.

ALTERNATIVE B

Design Goals and Theme

This alternative stresses the prevention of disruption in dense inner city neighborhoods through the provision of mobility by transit. The relative emphasis between suburban line haul extensions and inner area coverage intensive service can be varied as a set of sub-options. The provision of increased highway mobility through arterial improvements and traffic operation improvements for either radial or lateral mobility can also be varied within this alternative as another major sub-option.

1. Expressways

No new expressways -- which is to say, no Inner Belt, Southwest Expressway, Route 2 Extension, Third Harbor Tunnel, relocated

I-95 North. A sub-option inherent in this option is that of delayed expressway construction, of those systems described in either A or B until after all other elements had been completed and the "need" for expressways was re-examined. This is also a recognition that virtually no decision is made for all time.

2. Parking

Substantially greater parking capacity might be provided at Route 2 - Alewife Brook Parkway and at other points on rapid transit lines. These facilities would be designed to accommodate the higher transfer traffic that would be forecast in comparison with other alternatives providing greater highway access to the inner city.

Increased fringe parking would be provided at other points where transfers might be encouraged to new or improved express bus commuter service -- generally along major radial highways. Parking fees would be nominal at all fringe lots or at the mode-mixers to encourage transfers to transit. All-day parking charges at downtown locations would be set as high as feasible to discourage auto commutation. The number of required core parking spaces would be substantially reduced in comparison with previous forecasts and other alternatives providing greater highway capacity. The actual amount of parking consistent with this alternative and all others would be determined by forecasts of auto commutation that would occur under the specified program packages and by forecasts of short-term parking needs.

3. Arterials

Sub-options for arterial improvements within this alternative cover a very wide range. The range might be characterized as running from a very heavy emphasis on transit, and a de-emphasis on private auto commutation to a program for very substantial improvements in highway mobility through arterials and traffic operations improvements.

Assuming an emphasis on transit, arterial improvements might be limited to:

1) Those to accommodate truck traffic and encourage routing away from residential areas and retail centers as much as possible and feasible.

2) Traffic engineering improvements designed to provide continuity of flow for internal traffic within the core and off-peak through-movement, and to discourage traffic through residential areas, and through the heart and retail centers.

3) Connections to fringe parking transit terminals.

4) Those to accommodate base period (non-peak hour) traffic not reasonably transferrable to public transportation.

A sub-option emphasizing highway mobility and some other mix of transit improvement might concentrate on improving the capacity and operation of existing arterial systems so as to improve radial and, in particular, lateral mobility.

The arterial improvements contemplated for this alternative are those which can be implemented with a minimum amount of disruption. This implies emphasis on upgrading existing arterials through such conventional measures as widening (particularly at intersections), channelization, improved markings, signing and signals, reversible and one-way street operations, and grade separations at critical intersections. Previous arterial planning work done by municipalities will be synthesized and supplemented to form an efficient regional grid.

4. Operational Improvements

The type of arterial improvements described above shade over into operational improvements for existing roadways. The same ends of the spectrum as in arterials exist in terms of "transit emphasis" and more highway mobility. Operational measures could thus range from devices or procedures mainly aimed at facilitating the flow of buses or improving transfers to bus or rail transit, to a full application of new ideas and developments to make maximum use of existing expressways and arterials for auto vehicles also. While operational improvements are assumed for all alternatives, some ideas might include:

1) Computerized control of very large systems of traffic signals.

2) Metering of ramps to maintain smooth flow and increased volume on expressways, or parkways.

3) Special expressway lanes for use of buses and car pools with car occupancy greater than perhaps three persons.

5. Transit

This alternative implies by the restriction of expressway

construction in the inner city a much greater emphasis on transit than the other alternatives. Thus, without competing expressways to provide access to the inner city and the downtown, greater demand might result for some or all of the transit extensions (or sub-options) described under Alternative A.

Under the sub-option in which greater emphasis is placed on transit mobility improvements than auto commutation, improvements to bus systems will be developed as sub-options of both suburban transit extension and inner city coverage transit improvements.

Thus, an alternative or supplement to a fixed rail extension in any given corridor might be a commuter bus service utilizing (a) an existing radial highway, (b) a specially constructed busway, or (c) a reserved lane on an existing expressway. Further work is needed before these sub-options can be adequately defined for evaluation, in particular on the provision of new routes and the feasibility of operating such devices as:

1) Special "bus only" ramps at critical locations.

2) Electronic devices to activate traffic signals.

Improvement of the non-line haul aspects of transit service has been established as a major goal of the study and will be of central emphasis in this alternative. In order to provide adequate, attractive service to a range of potential users, a high level of "frequency" and "coverage" are considered vital.

The "coverage-intensive" concept emphasizes the needs of population groups who have high levels of dependence on transit for other than just the home-to-work trip.

Coverage is emphasized because of the interrelationship of transit service and land use. Urban sub-areas which are capable of supporting this kind of service have certain characteristics: high residential density, relatively close proximity to other activity centers, and low auto ownership rates. In some areas, low income is correlated with this pattern, in others the existence of a well served transit corridor results in significant increases in land use density and property rents. In short, the patronage base for this improved service is not confined to the poor, the handicapped and the elderly, but represents a potentially very broad cross section of urban citizens.

A variety of mechanisms to provide the service will be investigated including, but not limited to:

1) A Guaranteed Service Concept -- where a variety of different modes would provide a specified level of service at a

guaranteed price, employing fixed route services, demand activated vehicles and taxis.

2) An Increased Community Accessibility Concept -- involving changes in the service to critical social services and activity centers through the operation of jitney-type local operations, multi-fare taxi rides and so forth. Major public investment would still be channeled into improvements of bus operations on arterial streets through routed service into downtown and network connections stressed as critical for inner city service.

3) An Improved Feeder Concept -- which would rely chiefly on improving the operation of existing bus service by modifications of fare schedules, improving transfer facilities, utilizing new equipment and so forth.

4) Feeder to Line-Haul Concept -- which would concentrate on developing bus services as feeders to the proposed line-haul transit improvements.

6. Mode-Mixers

No commitment is made within this alternative to specific locations or design of such elements. As an illustrative example of what is meant by the concept of mode-mixers, the auto-rail transfer facilities near Route 2 and the Alewife Brook Parkway might be substantially enlarged in capacity and integrated in a structure designed to provide rapid, easy transfer. Similar transfer facilities, but perhaps of lesser scale and perhaps lacking parking structures, would be located on other rapid transit lines, at points selected to encourage maximum transfer without disruption of existing communities, and without pre-empting opportunities for joint development. Generally these transfer points would be located at points where inbound traffic encounters heavy congestion.

ALTERNATIVE C

Design Goals or "Theme"

This alternative stresses the provision of highway mobility and transit mobility. It compromises somewhat on the goal of minimal disruption to core neighborhoods but maintains a goal of careful design and compensatory programs to fully alleviate any damages. Sub-options in regard to transit mobility range from relatively heavy emphasis on suburban-to-downtown commuter service, to a heavy emphasis on the kind of improvement to inner

city service described in Alternative B. Sub-options on expressways within this alternative can range widely. The major point is that some expressways may be reduced in scale from the EMRPP system and the expressway system may not include all the links within the EMRPP system.

1. Expressways

This alternative contemplates an intermediate level of expressway construction between A and B. In some or all cases, the scale of the proposed highways might be reduced from eight to six or even four lanes. Both full and partial networks will be defined and tested.

1) Network to include all EMRPP links, but at a reduced scale, e.g., reduced scale Inner Belt, Southwest Expressway I-95 relocated through East Boston and Route 2 extension.

2) Reduced scale EMRPP network with the Western Corridor circumferential alternative (in the alignment as developed by the City of Cambridge) substituted for the Inner Belt. The possibility of merging the Western Corridor circumferential alternative into the Massachusetts Turnpike extension at Brighton and converting the remainder of the Turnpike into a free road through refinancing would be a subset study.

3) A set of networks with reduced scale links and interface with the transit system, e.g.,

   (a) A reduced scale Southwest Expressway might run from Route 128 to Forest Hills with a Mode Mixer to provide efficient transfers to transit for downtown traffic.

   (b) Route 2 to terminate at the end of the proposed MBTA extension from Harvard Square to Alewife Brook.

4) A reduced scale inner city distribution system utilizing the Boston portion of the Inner Belt and either the Western Corridor circumferential or the Cambridge Inner Belt, but with no more radial expressway connections, e.g., no Route 2, no Southwest Expressway, no I-95/Harbor Tunnel.

2. Parking

The relatively higher usage of transit for downtown movements may permit the reduction of downtown parking supply relative to Alternative A.

3. Arterials

Arterials would be improved within this alternative to help replace the loss in mobility resulting from the reduction in scale or deletion of particular expressways. Possibilities of this sort might include some improvements in capacity of arterials at the core end of the Southwest Expressway, and/or a new Charles River crossing near the Boston University Bridge from the Western Corridor Alternative (or merged Turnpike Extension) to a new arterial following generally the alignment of existing Albany and Portland streets. Other arterial improvements might be included as presently planned or as defined through careful review of the results of Task A.

Such sub-options might be creatively and carefully developed for anlysis of this kind of alternative throughout the process. The substitutability of arterial and traffic operations improvements for reduced scale expressways will require sensitive analysis.

4. Operational Measures

A sub-option exists of utilizing traffic operations measures with more or less emphasis on moving transit vehicles as compared to private autos. Some traffic operations improvements will be provided in all alternatives and sub-options. As in Alternative A, identification of possible improvements will benefit from a statewide TOPICS study and techniques to improve the operation of freeways and parkways, and provide for the construction of specially reserved transit lanes on freeways will be studied. Other traffic management measures will include, as examples, signing to encourage routing away from bottlenecks, synchronized signals, channelization, improved markings, and so forth. The goals of the operational measures would be both to complement the service of expressways and major arterials, and to help replace that service in areas or directions in which it was relatively lacking.

5. Transit

Relative emphasis between transit extensions and coverage-intensive service is a sub-option as in the other alternatives. "Hardware" is also a sub-option. As transit is described quite fully in Alternative B, and possible extensions are listed in Alternative A, it is sufficient here to indicate that Alternative C is intermediate between A and B in terms of its relative emphasis on transit as compared to auto mobility.

The same transit extension sub-options as listed in Alternative A exist in C. The same transit coverage and transit extension sub-options exist in Alternative C as are discussed in Alternative B.

6. Mode-Mixers

The importance of mode-mixer facilities in this alternative is intermediate between A and B.

PART TWO

STUDY ELEMENTS

INTRODUCTION

Part Two contains detailed descriptions of each of the 14 Study Elements, plus tables at the end giving budget estimates broken down by phase and specific subtask.

The material in Part Two is not meant to stand alone, but rather to be used as a technical reference to supplement Part One. Important aspects of the Study, including its purpose, the decision-making process, organizational framework, the alternatives to be studied and the criteria to be used throughout for design and evaluation of alternatives are not directly addressed in Part Two since these are covered in depth in Part One. A reading of the Introduction and Summary in Part One should give sufficient understanding of the context for the Study Elements.

STUDY ELEMENT 1

Study Management

Management of the Boston Metropolitan Area Transportation Study will be a difficult and challenging requirement.

Importantly, it will assist in the development of a transportation planning process to evolve and be implemented under the leadership of the new Secretary of Transportation and Construction.

The study will be managed in much the same way as the study plan was developed. It will be directed by a Study Manager selected by the Governor, who will work in continuous close consultation with the Steering Group and Working Committee, as described in Part One, Section II. He will be assisted in the study management function by a small core interdisciplinary staff.

It must be recognized from the outset that the study plan and process is substantially different from any metropolitan transportation planning activity previously undertaken, including the joint concept team efforts in Baltimore, Chicago, Los Angeles and others.

To fully comprehend the scope of the study management element, it is necessary to be fully aware of several fundamentals of the study plan:

1. It contemplates the development of a plan or set of plans (program packages), providing for substantial improvements in the movement of people and goods along with other complementary actions designed to protect and enhance the environment in the most comprehensive sense of the word.

2. The study process will be iterative. It does not begin with a fully articulated or rigid set of program package alternatives.

3. It will be fully participatory in that it will provide for public involvement throughout the iterative process, make available technical assistance to private groups so that they may make positive contributions, and keep the public continuously informed.

4. This study plan contemplates the realistic development of multi-mode and mixed-mode facilities and services, taking full advantage of the opportunities created and extended by the Urban Mass Transportation Assistance Act of 1970 and the soon to be approved Federal-Aid Highway Act of 1970.

5. It provides for multi-value planning in which a wide range of political, economic, social and environmental values are considered in the same spectrum as transportation values, so that transportation decision making may be multi-valued from the start, rather than oriented almost exclusively towards transportation user values until a late stage, with efforts then made to accommodate other societal values to an already firm transportation plan.

The Study Manager's authority and responsibility will be that of the Governor to the extent that powers are delegated. It is anticipated that the Study Manager will have full responsibility for carrying out the study plan, assigning personnel and resources, and ensuring that deadlines are met.

The Study Manager will not have authority which supersedes the statutory authority and obligations of any agency. His authority and responsibility is that of the Governor to the extent it is delegated.

The core staff to be assembled by the Study Manager will consist of experienced personnel trained and skilled in the various relevant professional disciplines as well as having practical experience in the application of their skills within a complex public affairs framework.

Most importantly, the Study Manager and core staff will be responsible for thoroughly integrating the work activities and the flow of study results in order to fullfil the fundamental objectives listed above.

Program Packages

Several of the Study Elements will contribute to the development of program packages. The study management will be responsible for directing the work activities and the timing to make certain that related and integral information is brought together in a cohesive fashion for each alternative in each decision situation. This means, for example, that there must be a continuous information loop between the group working on transportation system design and groups working on other elements such as environmental protection, housing relocation and replacement, neighborhood cohesion, etc. The management team will

be responsible for making certain that the information flow is developed and maintained, that it is directly related to design and evaluation criteria, and that it contributes to program package refinement and evaluation. The aim is to avoid the experience of some past efforts in which transportation facility decisions were made, and then other social, environmental and economic factors were forced to accommodate to the decision. In other words, traditional transportation investment criteria are inherently neither more important nor less important than other criteria used in the analysis and evaluation process.

Hopefully, program packages can be developed around which consensus will form. Regardless of whether this occurs, all taking part in the process will have access to full information and will be able to articulate their positions from a standpoint of informed opinion. The Study Manager will be responsible for accurately and fairly presenting all recommendations and positions to the Governor and other elected officials.

Iterative Process

The study plan provides for iterative planning and for staged decisions. In addition to the three scheduled cycles of plan making, the management staff will maintain the flexibility necessary to provide for sufficient analysis and evaluation to fully explore alternative program packages in each decision situation. This means that the interdisciplinary team must closely supervise the work activities of the several Study Elements, making adjustments as necessary to focus attention on critical issues, projects or components of program packages in order to facilitate decisions. This refining process will be one of the most important responsibilities of the management team and must be carried out in full recognition of the design and evaluation criteria in close working relationship with the Steering and Working Committees, and through workshops and other communication devices. Thus, no single element will be brought to decision ahead of other elements and dominate all other considerations. The study management will facilitate staged decision making by continuously attempting to identify components of the transportation system on which consensus can likely be reached. These components might include ones common to all alternatives being studied, ones on which decisions will not greatly affect other decisions not yet made, and ones for which compromise can reasonably be expected to be achieved.

Participatory

The management staff will have the central responsibility for making certain that all participants in the process have full access to the flow of information generated by the Study Element

work activities and the analysis and evaluation process.

The management staff will be responsible for the development of regular progress reports and briefing sessions with state, regional and local officials, and with private groups. It will provide or make provision for technical assistance to groups which require such help in developing ideas, suggestions and proposals, or in analyzing and evaluating alternative program packages in their various stages of development.

The management staff will provide or make provision for the development of graphic arts and other presentations to assist all participants in understanding the integral relationships among the various activities and their bearing on the complex criteria either already established or yet to be established.

In the participatory process, the management staff plays several roles: dissemination of information; provision of technical assistance; development of creative ideas and proposals in response to participants' views and concerns; integration of evaluations by private groups and others into the general evaluation process; and the conduct of public meetings at key decision points in the study process. These processes and activities are more fully discussed in Sections II and III of Part One and in Study Element #2.

In addition, the management staff is responsible for the administrative requirements of the study, including a continuous assessment of work activities in order to provide efficient and timely results.

Multi-Mode Orientation

The primary factor which will govern management staff activities in this area will be a continuing commitment to the principle that transportation is the movement of people and goods from place to place regardless of mode or combinations of mode, and that transportation must take its place with all other social, economic, political and environmental values which are brought to bear in the process.

The management staff will continuously assess transportation elements in the light of established criteria and a realistic assessment of potential resources available to carry out program packages which are otherwise feasible. The management staff will have no predetermined commitment to any particular form of transportation or transportation service characteristics for any particular section, area, corridor or neighborhood. The management staff will recognize that transportation service can

be provided by different mixes or combinations of modes.

Multi-Value Orientation

The management team will be composed of trained and experienced personnel from a wide variety of professional disciplines, as a means of bringing multi-value planning and decision making to the study process. Such disciplines as political science, law, engineering, sociology, architecture, systems analysis and environmental planning should be represented on the study management team.

The multi-value orientation will also be insured through the extensive provision for analysis of transportation impact as well as transportation user effects, and for the continuous involvement of public agencies and private groups having a wide range of responsibilities, priorities, and value perspectives.

The management staff, moreover, will continuously direct activities of the staff working on substantive Study Elements with the aim of ensuring that the full range of values and criteria are thoroughly exposed to study, analysis and evaluation.

Coordination with Other State Organizations

The study management will have responsibility to fully coordinate all activities with other state organizations including:

1. All legislative work -- the Joint Legislative Committee on Transportation, other units of the General Court, and the Governor's Office.

2. All administrative mechanisms -- the Governor's Office, the Office of Administration and Finance, agencies involved in the new Department of Transportation and Construction, and other agencies or municipalities as appropriate.

3. All ongoing planning activities -- State agencies responsible for transportation planning (DPW, MBTA, MDC) and municipalities through which transportation corridors pass. This must include coordination with projects and programs not explicitly included in this planning review, such as TOPICS, the South Shore extension, and the Leverett Circle Bridge.

4. The North Shore Planning Review.

5. The Governor's Intercity Transportation Task Force.

STUDY ELEMENT 2

Community Liaison and Technical Assistance

The unique participatory process within which the restudy is being conducted is described in Part One (Sections II and III) of this report. Recognition is also made in that Section of the inherent difficulty in obtaining widespread participation in a planning activity which has implications for the entire metropolitan area as well as for municipalities, neighborhoods and individuals. While the entire study plan is a reflection of attempts to overcome these problems, the provision of an adequate program of community liaison and technical assistance is regarded as critical to the maintenance of widespread public support for the transportation planning process. Both municipalities and private groups will have two levels of participation available to them. They will be free to participate weekly at the Steering Group meetings, or merely to receive briefings and provide comments and suggestions every six weeks or two months. They will be free as well to move from one level to the other as the prominence of issues they care about waxes and wanes.

Aside from the special work elements described below, participating municipalities and private groups will have the opportunity to advise on the selection and supervision of all other consultant staff through the mechanisms of the Steering Group and Working Committee.

Involvement

Despite the fact that the Study Design phase of this project has been carried out with an unprecedented amount of public and private group participation, it is recognized that the process must be widened still further. Particular attention will be given to the attraction of widespread citizen participation in the study process during the initial stages of the formulation of program package alternatives that directly affect particular sub-areas within the region.

It is expected that each municipality will take steps to communicate with its individual citizens and citizen groups concerning the Study and its implications, and to receive and be responsive to Study inputs received from them. The municipalities are encouraged to transmit the views of citizens and

community groups directly to the Working Committee and Steering Group as well as to invite their attendance at study committee meetings. A municipality on the Steering Group may request of the Working Committee that it conduct community workshops in its own area to further citizen participation in the Study.

Similarly the private groups involved in the process are expected to inform people and groups in their areas regarding all important study matters.

State agencies, municipalities or appropriately qualified local groups might perform portions of the work described in this Study Element.

Although this Study Element deals specifically with activities designed to encourage and aid active participation in the Study, it is important to note that other Study Elements have been designed to accommodate the maximum feasible interaction with relevant interest groups, and have manpower budgeted for that purpose. In particular, Transportation System Design (S.E. #4), Joint Development (S.E. #5), Special Mobility Studies (S.E. #7) and most of the transportation impact elements.

Work involved in this Study Element has been organized under two major headings: Community Liaison and Technical Assistance.

Community Liaison

Community Liaison activities will encompass the following functions:

1. briefing of state and local policy boards and officials beyond the individuals who attend Steering Group sessions;

2. interacting with such officials to answer their questions, and to bring their viewpoints back to the Steering Group and Working Committee;

3. briefing and conduct of workshops for private groups, ranging from chambers of commerce to neighborhood associations to unorganized people in potentially affected neighborhoods;

4. interaction designed to incorporate the perspectives, ideas and proposals of private groups in the study, and to inform the Steering Group and Working Committee

of the evaluations made by private groups;

5. availability of some staff to interact with curious or concerned individuals in more informal fashion outside of workshops; and

6. conduct of well publicized public meetings at key decision points during the study.

Two mechanisms, community workshops and illustrated progress reports/graphic displays, are among the mechanisms which will be used so that the on-going study process will maintain, and widen, the substantial degree of public participation already achieved during the Study Design period.

Community Workshops

The objectives of the community workshops are to:

(a) provide insight into values and priorities of citizens at the community and neighborhood level, and

(b) to facilitate interaction with citizens in the design of alternative program packages which include facilities and services to eliminate or mitigate potential impacts of transportation system components.

Information both as to the location and purpose of the workshops will be provided through regular press releases in the local papers, speaking informally with local representatives and citizen groups, and mailings of progress reports to those expressing a desire to receive them.

At the workshops themselves, in addition to presentations, discussions and critiques, resource people from the professional staff will be available to work with small groups of residents, to explain details of the proposals and to aid in the development of alternatives. Technical assistance staff may be requested to aid further in the development of such locally generated alternatives (see Technical Assistance below).

Reports and Graphics

Reports and Graphics will be made available in a form which is understandable to citizens who are not practiced or knowledgable in the art of transportation planning. Graphic representation prepared by the study staff will be made available on program package alternatives for use in community workshops. Graphics, written reports, slide shows and briefings in

appropriate detail will be prepared in order to brief a broad range of interested groups ranging from local representatives and agency boards to local and national press.

General Information Center

To provide general information, a central information source will be developed with a widely publicized central phone number. Interested citizens and groups will be informed at this number of whom to see about their concerns. In the normal case, an appointment would be set up at a City or Town Hall near them. Two community liaison staff members might be assigned to this function. They could be available about one day a week at each of a variety of locations, perhaps two days at some where demand was particularly high. They would work with other personnel to arrange the more formal briefings and workshops for larger groups.

Special Site Offices

In some special cases where a significant amount of community involvement is projected (e.g., the development of a major joint development project) a "Community Planning Unit" may be established to provide a location for the collection and dissemination of information and the more frequent meetings that may be required for the development of local residents' input into the design and evaluation process. Maximum use shall be made of existing facilities and organizations.

Technical Assistance

Technical assistance is required to enable both municipalities and private groups to translate their ideas into responsible concrete proposals, and to assess the impact of potential projects upon their own interests.

If the objective of meaningful participation is to be achieved, it must be recognized that many of the private groups, municipalities and even some state agencies wishing to contribute to the study process lack the technical staff capability enjoyed by other major participants, such as larger state agencies. This lack of staff capability is made more serious by the necessarily tight scheduling of the study process called for by the Governor's program. In order to redress this imbalance, a pool of technical assistance, in the form of professional staff time, will be provided as a specific element of the professional services associated with the Study.

It is envisaged that this pool will be drawn upon to aid

in the evaluation of impacts on specific neighborhoods or groups, or to help in the preparation of specific components or modifications of alternatives by municipalities, neighborhood groups or other interest groups (e.g., conservation interests or chamber of commerce) for incorporation within the larger study.

Each interested participant may present its own request and justification for technical assistance resources, either directly or through the channel available to them for input to the Steering Group (e.g., the Municipal Caucus representatives). It will be necessary, however, to reserve resources for allocation throughout the study so that participants not yet identified or involved (in particular, additional localities and private groups) will not be excluded. It is anticipated that technical assistance will be allocated separately for each study phase or for parts of study phases.

The allocation of technical assistance will be through consensus by the Steering Group, with the Chairman acting as arbitrator whenever consensus is not achieved. While it is recognized that an almost unlimited sum could be spent on these functions, the study is committed to working within a budget ceiling that will require careful control to assure adequate accomplishment of all functions including technical assistance.

Finally, it should be emphasized that despite the range of mechanisms for participation outlined in this Study Element no community organizing or mobilization will be financed. The concern is two-way information flow (not merely education, which suggests one-way information flow), and the provision of expert technical advice to enable the various participants to participate in a responsible, effective, and timely manner.

STUDY ELEMENT 3

Use of Design and Evaluation Criteria

Criteria, their development during the Study Design Phase, and their general role in the Study have been discussed in Section IV of Part One. The design work wherein criteria are used to guide the development of plans, is described primarily in Study Elements #4 and 5.

The tasks of this Study Element are:

1. To refine criteria

2. To define standards

3. To synthesize the criteria, i.e. to organize the evaluation data (measurements or estimates of criteria) to be produced from all other Study Elements in a form necessary to effectively communicate these results to the Steering Group, Working Committee and other interested groups.

Definitions of Criteria and Standards

Criteria are defined as a set of scales, derived from statements of values held by all interested groups, to be used as the principal guide in designing and evaluating alternatives.

Criteria are not statements of values in themselves, but rather, more operational dimensions which;

(a) facilitate greater precision by staff and all participants in translating value statements into designs which satsify values to the greatest extent possible, and which

(b) provide yardsticks which can be applied to alternative plans and designs to communicate more precisely to all interested groups the degree to which these alternatives can be expected to satisfy their values.

Criteria are thus more specific and detailed than value statements. Insofar as feasible they will be stated both in qualitative terms and in terms which permit quantification at least to the extent that competent professionals can define categorical scales for rating impacts by degree of positive or negative effect and fairly unambiguously determine the particular category on the scale into which particular effect of an alternative should be placed. These categorical ratings

are commonly termed "ordinal" scales since they permit a ranking order to be determined for that scale for all alternatives being evaluated.

In addition to qualitative assessments, a particular type of impact may be evaluated by criteria which involve both ordinal scales and quantified scales of the more familar type for which numerical values can be assigned (either "ratio" scales which have a naturally defined zero point, such as dollars, time, houses or jobs; or "interval" scales, which have no naturally defined zero point such as most psychological scales and other defined scales used by behavioral scientists). For example, noise impact may be measured in decibels, a ratio scale, or on an ordinal scale which has been constructed to translate ranges of noise into categories by the degree to which noise disrupts human and social activity or causes pain.

The criteria listed in Section IV of Part One have been related in their presentation to the value statements from which they were derived. In general, however, they have not yet been developed into specifically defined scales, although many of the scales are clearly indicated (costs, time, etc.).

Particular quantitative or categorical values on any of the scales used for a criterion can be selected as "standards." A standard can be a minimum value which all alternatives must meet (e.g. 15 minute headways on all transit lines between 6 A.M. and midnight), a maximum value (e.g. 60 decibels of noise from transportation sources at all residences) or a desired value (e.g. a particular employment level for the core).

Refinement of Design and Evaluation Criteria

Although a comprehensive list of criteria have been prepared which reflect the concerns and values of all participants, that list is not final. Individual participants have expressed a desire to obtain additional inputs from private interests, municipalities and community groups before initiation of Phase I work, which may refine and augment these criteria.

As Phase I begins, staff work will be required to define the actual measures which will be used in both Phase I and

and later phases based on viewpoints of particpants and on the actual design and analysis procedures to be used. These measures will include common monetary and non-monetary quantitative dimensions (e.g. dollar costs, acres of land, number of families requiring replacement housing, etc.) as well as categorical ("ordinal") scales created for the assessment and comparison of qualitative dimensions (e.g. a ten point scale for rating the degree of value, positive or negative, attached to such impacts as severance of specified pedestrian linkages in a community, the improvement of access to hospitals for elderly persons, or the disturbances of wetlands used by certain wildlife.)

Further changes in the criteria may be required later during the study as further interaction with participants occurs and as experience is gained with the process. Certain criteria may be dropped from further consideration by consensus if alternatives show no significant impacts in particular dimensions. However, no criteria will be omitted for which some groups continue to express concern. Other criteria may need to be added if new concerns arise or if existing criteria do not provide sufficient information for proper assessment of critical values.

Phase I criteria will be more general than those for later phases because of the use of shortcut methods and less detailed design definition. No criteria will be eliminated, but sets of closely related measures may be combined. For example, use of estimates of regional economic impact for a broad sector of industry (such as manufacturing) may be used instead of breakdowns for finer industrial categories (such as textiles, lumber and qualitative measures in Phase I (i.e. using ordinal scales whereas more definitive quantitative measures can be used in later phases. Wherever possible, however, estimates of quantitative measures will be provided.

In order to assure full communication of evaluation to both technically oriented and non-technically oriented participants, results of evaluations will be presented in both simple qualitative statements and quantitative terms whenever appropriate and desired by participants.

The refinement of criteria in Study Phases I and II will precede all evaluation work, but will occur as design and analysis work is initiated to permit necessary feedback between these functions. Actual design processes may require redefinition of criteria to assure effective responsiveness to values.

(See Figure III.1 for the scheduling of this and related work for each Study Phase.)

It is anticipated that the criteria used in Phase II will suffice for Phase III as well, although modest refinements may be called for by participants based on experience during Phase II.

Development of Standards

During Phase I the staff will assist the Working Committee in developing standards for certain criteria for which consensus is reached that specific standards are required. Such standards might include maximum or minimum values which cannot be violated (e.g. noise or air pollution levels), or desirable values (e.g. land development patterns) to serve as design objectives (see definition above).

Participants have stated a particular desire to have standards developed for environmental and quality of transportation service criteria.1/ The lack of such standards in the past has resulted in unacceptable negative impacts to particular groups. The staff will develop suggested standards, under the direction of the Working Committee and in consultation with interested participants, based on review of established standards from the most appropriate sources (Federal, State and local agencies, professional associations) or results of other previous related studies.

Participants have also stated a desire to adopt specific land development objectives. Attempts will be made to achieve consensus among participants on a single set of such standards which would include population and employment levels for the metropolitan area, the individual municipalities and the downtown area of Boston and Cambridge. Previous economic, population and land use studies and plans of the MAPC, EMRPP and "Task A" will form the starting point for defining these land development goals. Preliminary results of the 1970 Census will be reviewed as a basis of comparison to determine the reasonableness of previous plans and forecasts and to make modifications as necessary.

If consensus cannot be reached on a single set of standards for land development, it may be necessary to define two or possibly three sets of such standards, each of which is supported by a subset of the Steering Group and Working Committee.

Minimum and maximum standards will provide constraints or specifications for designer's to follow in Study Elements #4 and 5. Desirable standards such as land development objectives

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1/ For perhaps the best example of previous work on transportation system design standards see the final reports in three volumes of the Southeastern Wisconsin Regional Land Use and Transportation Plan.

will provide target values for designers to attempt to achieve. If evaluations show that standards are not met, redesigns in the next Study Phase will require changes to meet minimum or maximum standards or to more nearly achieve desirable standards (unless consensus is reached that the cost of modifying designs is too great and that the standards should be modified accordingly).

Definition and revision of standards will be concurrent with work on criteria. (See discussion of timing of work on criteria above and Figure III.1).

Synthesis of Criteria for Evaluation

Most of the Study Elements have responsibility for producing measures for specified criteria (See Figure IV.1) All criteria will be estimated for all alternatives for each phase of evaluation (except that Phase I criteria will be estimated at a more general level as noted above). It is the task of this Study Element to organize these results in a form necessary for effective communication to the Steering Group and Working Committee and to aid them in their attempts at reaching consensus.

A distinction is made between technical evaluation and evaluation by participants, particularly those groups directly affected. The study staff will provide all technical evaluation data 2/ and present these to participants through Steering Group and Working Committee meetings and through Workshops and public meetings (S.E. #2). All interested groups directly affected will be asked to provide further evaluations based on the technical evaluations and other data describing the alternatives. Because of their direct interest, these groups may be able to provide additional feedback necessary for complete evaluation. This feedback will be incorporated in final staff presentation of evaluations to the Steering Group and Working Committee, and is also expected to be communicated to committee members by other participants directly to aid them in the selection process.

A special type of evaluation of alternatives has been requested by the municipal caucus: The results of Study Element #14, Neighborhood Cohesion and Transportation Needs will yield in part a list of priority transportation needs for each particular potentially impacted neighborhood. Each alternative transportation system being tested will be

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2/ Much of the basis for technical evaluations will, of course have been developed through continuing interaction with interested groups throughout the Study.

evaluated in terms of the degree to which it satisfied or frustrates these identified local needs.

One mechanism for communication of alternative designs to all participants will be a set of visual portrayals of all designs. Major facilities will be shown on topographic maps at regional and corridor scales. Joint development designs and important transportation facilities will be thoroughly described by architectural sketches and drawings from various perspectives.

Results of all the evaluations will be presented in full detail, organized to facilitate comparison of alternative program packages for each criterion. However, the volume of information that will be produced for each alternative will be enormous. Therefore, in addition to the presentation of the detailed evaluations the staff will be required to develop means satisfactory to the participants, for synthesizing this information into forms which more readily facilitate comparisons and overall evaluations of the alternatives.

It will probably not be possible to rely on a single overall quantitatively defined criterion for evaluating and ranking alternatives. The list of criteria include diverse measures which include monetary values, quantitative non-monetary values, and qualitative assessments. The Working Committee will probably not be able to agree on the relative weights to give to each criterion to provide a means for achieving a single overall measure of the differences in net benefit among alternatives. However, to the extent that the Working Committee can agree on weightings to give to the various criteria, summary comparisons and rankings of alternatives can be made.

A social benefit-cost evaluation will be produced. All projected differences among each pair of alternatives for all monetary values and all other dimensions which can reasonably be translated into monetary values will be discounted to present value using an interest rate recommended by the Federal Office of Management and Budget (recently 10-12%). Results will be presented in terms of net differences in present value among alternatives, together with data on all other criteria excluded from these calculations. All criteria for which the Working Committee can agree on relative weightings can be incorporated in the summary evaluation measure (net difference in present value.) If the Committee can reach consensus on delegation of this task (determination of weightings) to the staff a single summary evaluation measure and ranking of alternatives can be produced. However, it must be recognized that it is unlikely that Committee members will agree to accept the results of such a process.

The results of the benefit-cost analysis will be tabulated by distribution of benefits and costs among various classes of users and non-users of the transportation system.

In addition to the benefit-cost analysis the staff will reduce the several scores of criteria measurements into a much smaller number of summary measures of evaluation by major category of type of impact (perhaps a dozen categories). These measures will be partly monetary and partly ordinal ranking scales for each category. These summary evaluations will be presented in graphic form comparing the alternative on each of the categories of evaluation, supplemented by text giving additional detail. Each summary measure will be produced by staff by assigning relative weightings for each of the detailed criteria making up major categories of criteria and combining them into the several summary measures.

Summaries will also be provided of the comparative impacts of the alternatives on all major categories of groups affected. This will be presented in the form of a table with affected groups listed on one margin and the alternatives on the other; cells of the table will show amoung of benefit or cost by type of impact, for each group and alternative.

STUDY ELEMENT 4

Transportation System Design

This Study Element, along with #6, "Land Use and Travel Forecasts," and #5, "Joint Development and the Development of Alternative Program Packages," is one of the three largest called for in this Study Design. It encompasses almost all of the transportation engineering work, as well as substantial portions of the efforts of other design professionals, and involves much of the required interaction between professional staff, the Steering Group and Working Committee, state and local agencies, and private groups.

This Study Element will also require the greatest integration with other Study Elements, since it will both affect and be affected by work on every other task.

The major outputs of this Study Element are:

1. To provide a sketch plan 1/ in Phase I of the Study for each of the transportation systems and their components identified among the alternatives in Section V.

2. To provide information required by other Study Elements during the first Phase of design and evaluation work. These requirements include network descriptions for each alternative for land use and travel forecasting (S.E. #6) and descriptions of program package aspects affecting the criteria to be analyzed in other Study Elements.

1/ The term "sketch plan" has diverse meaning among the design professions. Its sense here is elaborated in subsequent pages, particularly in the description of work for Phase I. In brief, sketch planning will be a multidisciplinary process which will yield sufficient data on all alternatives to facilitate informed evaluation and selection during the first plan-making cycle, which covers a four month period. Analyses will be conducted in sufficient depth to permit a determination of the engineering feasibility of each alternative design, the approximate costs and other data required for a balanced evaluation. The degree of detail required for balanced evaluation must vary depending on the degree of concern over various criteria in each decision situation.

3. To directly provide certain estimates of criteria (costs and performance measures) for the initial evaluation of alternatives.

4. To provide plans and information identified in 1,2, and 3 above for Phases II and III in greater depth. Most importantly, this Study Element is responsible for providing plans and designs for all transportation components of the program packages to be selected for implementation during the study.

The following material is covered in this Study Element Description:

... Participation in design
... Relationships with other Study Elements
... Description of the work by study phases
... Description of the work by type of transportation component
... Listing of tasks
... Specific results to be obtained

Participation in Design

As the study gets underway, a series of briefings will be held with interested municipalities, neighborhood groups and other private interests to inform them of the study, invite their participation, and request that they begin to formulate inputs to the study (see S.E. #2, Community Liaison and Technical Assistance). It will be stressed that groups wishing to contribute to the design of transportation alternatives should make their desires known promptly to the study management, so that arrangements can be made for their participation from the outset.

A primary vehicle for participation in design will be the regular meetings of Steering Group and Working Committee. These groups will participate in the guidance of all work from the outset including refinement of criteria, development of minimum, maximum and desirable standards 2/ and land development goals,

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2/ This does not imply that lay participation will be invited to suggest changes in standards which are based on technical engineering requirements such as geometric standards for highways or safety standards for transit equipment. Design standards which may be of substantial interest are likely to be those dealing with frequency and quality of transit service, environmental effect, visual effects, etc. No standards, however technical, are excluded from consideration though, to the extent that values not adequately considered in the development of accepted standards are raised and can be shown to provide justification for changes in these standards.

sketch plan design and technical evaluation work, redesign, etc. Results will be reported continuously so that items may be flagged for debate and redirection as necessary. No design work will be completed by professional staff without full communication of the substance and nature of the work. Section II, Part One "Overview of the Planning and Decision Making Process," describes the operation of these committees in greater depth.

Another important mechanism for participation in design is the series of workshops planned. Workshops will be conducted in communities which would be directly affected by proposed transportation projects and may be conducted elsewhere as the need is determined. These workshops will provide continuing interaction between staff and all interested groups from the outset. The depth of involvement of these groups in all aspects of the work, beginning with refinement of criteria and development of standards and continuing through evaluation of designs in later phases, will be primarily determined by the expressed needs of the groups, subject to the Working Committee's need to properly control and allocate study resources. In-depth participation will be facilitated by technical assistance, allocated in accord with the procedures previously specified (S.E. #2).

In addition, public hearings will be held as required for location and design of Federal Aid highways and for all Federally aided transit development programs.3/ Other public meetings will be conducted by the Steering Group, the Working Committee or participating agencies as deemed advisable during the course of the study. Records of all workshops will be maintained to document the participation process, the proposals advanced, and the positions taken.

Sub-area committees will be formed for all corridors or subregions to accommodate the desires of groups to participate more intensively in the study of particular parts of the regional system. Additional groups having limited geographic scope of interest can participate through this mechanism. Such committees would have chairmen and membership appointed by the Study Manager, and would be delegated responsibilities in similar fashion to the delegation which has been made to the Working Committee. They will work under guidelines to be established by the Study Manager.

Openness will be required. All Working Committee and Steering Group meetings will be at announced times and places and open to the public. The status, location and availability of all project materials will be communicated through monthly pro-

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3/ Federal Highway Administration, Section 2 of the Policy and Procedure Memorandum 20-8, January 14, 1969. Urban Mass Transportation Assistance Act of 1970 adds hearing requirements similar to the highway legislation by adding a new section 3 (d) to the Urban Mass Transportation Act of 1964.

gress reports. All working materials will be open to interested groups for inspection.

Relationships with Other Study Elements

The transportation system design work requires inputs from most of the other Study Elements.

S.E. #2, Community Liaison and Technical Assistance assists in providing a broad range of inputs through participants as described in the previous subsection, "Participation in Design."

S.E. #3, Use of Design and Evaluation Criteria, provides a refinement of all design criteria, design standards and land development goals.

S.E. #5, Joint Development and the Development of Alternative Program Packages, is a concurrent design process to accommodate transportation impact components of program packages in integral fashion with transportation designs. Since they must both, therefore, perform as part of a single design process, they provide continuous inputs to each other. S.E. #5 also involves collection of important data on land use, topography, man-made facilities, natural environment, social and institutional facilities, etc. which are essential in transportation design work.

S.E. #6, Land Use and Travel Forecasting, provides information on all types of demand for transportation, the quality of service, the impacts of transportation on land development and the degree to which the transportation system alternatives serve to achieve land development goals. Although results of Phase I work from S.E. #6 will not be available to assist in the design of the initial sketch plans, these results will provide major inputs for redesign and modifications to sketch designs in subsequent phases of the Study. Also, results of previous land use and travel forecasting work performed as part of the EMRPP and Task A studies will be used in Phase I design work. 4/

S.E. #7, Special Mobility Studies, provides information on latent demand for transportation and the importance or value of that demand. This data forms the direct basis for designing new services and improvements in quality and frequency of existing service for persons lacking adequate mobility.

S.E. #8, Technological Planning, provides design inputs for promising new systems and components which may augment or modify designs for current technology.

4/ EMRPP, Recommended Highway and Transit Plan, 1968.
EMRPP, The Development of a Traffic Forecasting Model, 1969.
MAPC, The EMPIRIC Model and Land Use Forecasting.
Task "A" Committee,"Task "A" Study (draft)", June 1970.

S.E. #9, Administrative and Legislative Studies, provides information on political, financial and legal feasibility of implementation, and therefore may suggest modifications to plans and designs to increase their feasibility. Feasibility of funding various components of the expressway network under the Interstate system will be part of this analysis.

S.E. #10, Environmental and Conservation Studies, provides information on constraints on the location of transportation facilities due to the impacts that would occur, and provides information upon which to base special design features to minimize environmental impacts.

S.E. #12, Replacement Housing and Family Relocation, provides data on the location and number of housing units by quality and the difficulty of relocating households to guide the location of transportation facilities to minimize impacts. It also provides information on potential sites for replacement housing, which may influence design of transportation facilities. Study Element #13, Business Relocation and Employment provides analogous information for firms and jobs.

S.E. #14, Neighborhood Cohesion and Transportation Needs provides data on the quality, importance and spatial aspects of social, institutional and economic linkages within and between neighborhoods, and data on special local transportation problems and opportunities to guide design and location of transportation facilities.

In addition to the design inputs from all of the above Study Elements, similar linkages exist for evaluation. The transportation designs directly provide the basic data for assessing the impacts on family and business relocation (#11,12 & 13), and for predicting travel and quality of transportation service to be provided (#6). The designs, together with the predicted travel and quality of service, provide the basic data for assessing impacts on environmental and conservation values (#10), neighborhood cohesion (#14), employment opportunities (#13), unmet transportation needs (#7), land development patterns (#6) and on regional economic effects (#11).

Description of the Work by Study Phases

Phase I

Phase I work involves sketch planning of each of the transportation components for each of the alternatives. These components will include expressways, operational measures on the expressway system, rail rapid transit; suburban railroads; bus

rapid transit; local service coverage transit; experiments or demonstrations of new types of service or improvements in marketing; operational or transit-oriented TOPICS improvements; arterial and general purpose TOPICS improvements; parking supply and fee structure; transit fare structure; and promising new technology identified through S.E. #8. The nature of the sketch planning work for each of these components is described in subsections which follow.

The sketch planning process will, in some cases, involve incorporating work already accomplished by MBTA, DPW, MAPC, MPA, MDC, BRA and the City of Boston, Cambridge, and other localities. In many cases, modifications to previous designs will be called for by participants and incorporated. In other cases, new sketch plans will need to be developed in Phase I because of lack of previous work or because of major revision in previous plans desired by the Steering Group or Working Committee.

Sketch plan design work, as well as all phases of design, will be guided by all criteria, not merely by those dealing with transportation costs and performance. The design process will be an interdisciplinary design team effort, under the immediate direction of the study management, and involving each of the design professions (engineering, planning, architecture, urban design and landscape architecture) aided by other expertise as required (sociology, economics, social psychology, ecology, housing and manpower).

The relative amount of attention given to the various design criteria and the specific way in which they are applied in each corridor will be tailored to the problems, concerns and circumstances of the particular affected community.

The sketch plan design methods to be used will be a creative synthesis of the most appropriate approaches of the design professions. Design principles 5/ will be developed and applied to seek optimal designs based on the criteria. At the regional system planning scale, applications will be made of recent concepts of network optimization 6/ and new concepts in the use of transportation planning methods for sketch planning. 7/ Com-

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5/ Design principles are concepts or guidelines used in the process of design which aid the designer in efficiently creating designs which satisfy complex sets of objectives and requirements. Many examples of design principles can be found in the references which follow.

6/ Study Element #6, subsection of Work Program: "Phase I Analyses: Special Studies of Existing Travel, Expressway Spacing and Configuration and Possible Ranges of Modal Usage."

7/ Study Element #6, subsection C of Approach: "Need for Design Ability."

prehensive design principles developed by the Urban Advisors to the Federal Highway Administrator will be applied in all highway sketch planning location and design. 8/

At the project scale, planners, architects, urban designers and landscape architects have developed sketch plan or sketch design methods as part of their normal interaction with clients. 9/

In contrast, engineering design practice has not traditionally recognized a formal sketch planning phase as such. Highway and rapid transit engineering work normally proceed in staged decisions and increasing refinement from network configuration to route, interchange and station location, to preliminary and final design. Sketch plan engineering design work for this study will, in general, have to encompass approximately the level of detail normally associated with location studies. It will differ from conventional location study work, however, in several ways:

(1) The engineering work will be part of an interdisciplinary design team process, as noted above.

(2) It will be highly interactive, as noted above, and therefore may require several revisions during the course of sketch plan design.

(3) Network level sketch planning analysis work will be underway simultaneously, so that estimates of traffic volumes which will be available at the start will be very approximate. Sketch designs may have to be modified somewhat at the end of Phase I, or go through additional rounds of sketch planning to improve operational features of the designs if traffic volumes resulting from the network analysis (S.E. #6) prove to be substantially different from initial assumptions. 10/

8/ The Freeway in the City: Principles of Planning and Design, A report to the Secretary, Department of Transportation by the Urban Advisors to the Federal Highway Administrator, May 1968.

9/ One approach to the task of integrating diverse design requirements from the several desciplines in systematic fashion has been developed by Christopher Alexander in Notes on the Synthesis of Form, Harvard University Press, Cambridge, Massachusetts, 1966.

10/ It is important to note that the definition used for the task of designing to accommodate forecast traffic is not that of designing to provide capacity equal to whatever traffic volumes have been independently forecast. In practice, the capacities

(4) Since the Phase I time period is short, the sketch planning work will have to use preliminary data. Coarse estimates will frequently have to be made in Phase I. Formal requirements, for example, for expressway location studies, may not be completed until Phase II.

(5) Sketch plan engineering design work will frequently have to involve design features not normally encompassed by location studies. Such features as pedestrian linkages across transportation rights-of-way and buffers to diminish noise and glare may be critical to the choice of location of facilities, and therefore must be dealt with in sketch planning.

(6) Sketch plan design work may involve alternative designs within a single location as well as alternative locations (e.g. expressways of varying width or elevation). Such design work will be very preliminary for Phase I in comparison with typical requirements for preliminary engineering design work. In Phase I initial rough determinations will be made for horizontal and vertical alignment, for type, size and location of major structures and for other design features affecting community impact or joint development potential.

10/ (cont'd) of transportation facilities are commonly determined by many factors in addition to traffic forecasts. In this study, alternatives will be evaluated which vary substantially in the amount of highway and transit capacity provided. The methods of forecasting traffic in S.E. #6, explicitly recognize that traffic volumes and patterns in reality adjust to some level of equilibrium between supply (capacity) and demand. A given equilibrium may or may not include severe congestion; analysis will determine the quality of service throughout the system. Therefore, the task of designing facilities to accommodate forecast traffic becomes one of designing to provide efficient traffic operations and quality of service for a more or less constrained level of capacity and traffic volume. The determination of what level of capacity is to be provided for any facility is made as part of the choice among alternatives; the choice is influenced by considerations of quality of traffic service and many other considerations.

By the end of the second month, network descriptions in sufficient detail for the land use and traffic forecasting work (S.E. #6) will have to be prepared. These descriptions will include determination of transit fares, parking fees, travel times and distances, tolls (if any), capacities and configuration of all system linkages, but will not have to include alignment, elevation,precise location or configuration of interchanges, terminals or other design features.

During the second through fourth months, the various evaluations of sketch plans will take place as components receive sufficient design definition. Most of the elements of the evaluation process are covered among other Study Elements. The criteria to be estimated (i.e. the specific evaluations to be made) as part of this Study Element are listed at the end of this section.

Estimates of impacts upon all criteria (costs, service levels and all consequences) have been made for the alternatives; these results will be presented to the Steering Group, Working Committee and other interested groups. Synthesis of these results will be provided as outlined in Study Element #3. Sketches and other visual communication materials will also be prepared.

After presentation of the results of the Phase I sketch planning and evaluation work, the Steering Group and Working Committee will begin the process of attempting to reach consensus of which alternatives should be eliminated from further consideration, which should be modified and in what way, which elements can be accepted and recommended for implementation, and which elements and networks are to receive further, more detailed analyses, design and evaluation. The latter decisions are necessary to guide the Phase II in-depth work and, therefore, should be made as early as feasible so that work can proceed as scheduled.

It is likely that the Steering Group and/or Working Committee will desire further sketch planning and evaluation of compromises or modifications of alternatives during the period while in-depth study of alternatives is proceeding in order to reach decisions on system components or complementary elements of program packages before Phase II results are available. Depending on the degree of modification of initial sketch plans that is called for and the range of issues involved additional rounds of sketch planning may require from one to three months beyond the scheduled end of Phase I.

Phase II

More thorough elaboration, design and evaluation of alternatives will take place during months three through fifteen.

The process will be generally similar to Phase I but in greater depth. Network description will be prepared with greater accuracy and detail. Fewer alternatives will be involved; the actual number of alternatives will depend on the extent to which consensus can be reached on eliminating Phase I alternatives. There will be more concentration on longer term, more capital intensive components since decisions to implement or to proceed with more detailed planning of short term investments, policies, operational measures, etc. are expected to be made based on Phase I results to a large extent.

Criteria will be refined, made more quantitative and modified based on the results of Phase I work.

Interaction with local officials and interested private groups not directly represented on the Steering Group will be maintained through frequent workshops and presentation of interim results. Continuing inputs to the design process will be facilitated by the availability of technical assistance.

Although the Phase II in-depth design and evaluation work is not scheduled for completion until the 15th month interim results and complete results for components of the transportation system and elements of program packages will be presented as they are completed to facilitate staged decision-making, beginning about the 9th month.

The basic approach to the design work will be the same as for Phase I in terms of comprehensiveness of criteria, interaction with participants, interdisciplinary team effort and the creative process of integrating the methods of design from the several disciplines. The fundamental differences are that (a) more thorough data will be available, (b) greater time will be available for more depth and detail in the design work, (c) more conventional design methods can be used in the sense of depth and detail, and (d) redesign will be substantially guided by the results of Phase I evaluations and the consensus reached by the Steering Group and Working Committee.

Phase III

Based on previous experience, it is unlikely that Phase II will result in consensus on all components of a single system but rather that compromises, modifications and composites of components from different alternatives will be necessary to reach consensus, if it is possible to reach consensus at all.

To some extent these negotiations will have been in progress since Phase I. However, an additional period has been scheduled for this work. All detailed results will not have been available until month 15, and these results may cause changing viewpoints or assist in narrowing differences between opposing positions to the extent that a modest amount of further design work can resolve many differences.

By no means is it anticipated that all transportation system components will need to be subjected to Phase III analysis -- implementation decisions are to be staged throughout the process. Nor is it anticipated that consensus will be reached on all components by the end of Phase III. Where fundamental disagreement remains the Governor will be presented with 2 or 3 best options and all supporting positions.

This Phase III work can begin before the completion of Phase II for selected elements and last through month 17.

Description of the Work by Transportation Component

Expressways

Phase I work may involve sketch designs for two or more alternatives, as generally described in Section V, for each expressway corridor. These alternatives involve differences in design standards, numbers of lanes, profile,location, and type of rapid transit and transfer facility included, if any. It is anticipated that expressway design alternatives will generally be narrowed to one option in each corridor at the end of Phase I, although two options may be retained in some corridors if consensus cannot be reached.

During Phase II and III much of the necessary preliminary engineering work will be accomplished for all expressway alternatives not eliminated from further consideration in Phase I. More specifically, it is anticipated that work will be carried at least through formal location study requirements for expressways in all or most corridors, and that requirements for the determination of all major structures will be completed for one basic design in all or most corridors.

Many expressway sections have already been through preliminary engineering for at least one alternative location, profile and design. Exceptions include the Cambridge Western Corridor circumferential alternative (location study completed only) and the Third Harbor Tunnel and its expressway connections from the Southeast Expressway

to the presently designated I-95 North in Saugus (preliminary feasibility study completed only).

New location studies, in the depth required for formal approval of location, will be required as part of this study if the Steering Group and/or Working Committee reaches consensus in Phase II that a location for an expressway should be implemented, or at least retained as an alternative for further in-depth study, and this location is one for which a formal location study has not been completed. Possibly falling in this category are:

(1) Southerly portion of the Southwest Expressway (I-95) --environmental considerations may result in the desirability of revised locations.

(2) Cambridge Western Corridor Circumferential -- although the City of Cambridge has completed a location study, additional work might be needed to meet Federal requirements or to study variations in location which may arise. It is also possible that additional location study work will be required on previously designated alternative locations for the Inner Belt through Cambridge as contemplated in the Task B study (see draft memorandum of understanding between DPW and the municipalities of Boston, Brookline, Cambridge and Somerville).

(3) The Third Harbor Tunnel and its expressway connections for which formal location study requirements have not been completed.

Any required studies of alternative locations will involve work covered under several other Study Elements in addition to this one in order that all relevant criteria listed in Section IV of Part One are given appropriate attention in both design and evaluation of the alternative locations. In particular environmental, housing, business, joint development potential and community cohesion will be emphasized in all studies of alternative locations, both in sketch planning and in more formal location studies if required.

Preliminary engineering design work will involve similar integration with several other Study Elements. Joint Development work will have much greater involvement with this activity. New preliminary engineering (determination of horizontal and vertical alignment and type, size and location of major structures) may be rquired for sections of express-

ways for which new alternatives are being developed, if a significant portion of the Steering Group and/or Working Committee judges that these new alternatives should be implemented, or at least retained as alternatives for further in-depth study during the course of Phase II. Possible candidates falling in this category are:

(1) Expressways listed above as possibly requiring additional formal location study;

(2) A reduced scale Southwest Expressway, possibly with bus rapid transit facilities and major modal transfer terminal;

(3) A reduced scale Inner Belt, possibly with bus or rail rapid transit facilities; and

(4) Revised designs for portions of the Inner Belt to facilitate joint development opportunities.

Special study will be given to the potential requirements of new intercity ground transportation facilities in expressway corridors, in particular in the Southwest and the Third Harbor Tunnel and its expressway connections which are likely facilities to accommodate high-speed rail or other types of connections in the Boston-New York corridor and to the airport respectively.

Close liaison will be maintained with the Governor's Intercity Transportation Task Force to provide inputs to the analysis and to assess the probability of future recommendations for investment in such linkages.

The various types of technology which might be utilized in the various expressway and rapid transit corridors will be studied as a part of S.E. #8, Technological Planning. An assessment will be made of the justification for special design features in the corridors which would be required to accommodate likely new systems.11/

11/ A formal technical evaluation can be made by estimating the net present value (appropriately discounted future benefits minus costs), where expected benefits of the new system take into account probabilities of implementation (which may be estimated by Delphi techniques) and costs include expected present and future social costs as well as capital and operating costs.

Transit

Transit components include rail rapid transit extensions, new bus rapid transit lines, mode mixers, suburban rail improvements, special services and experiments and coverage intensive service improvements. Under each basic alternative program package the mix of components outlined in Section IV of Part One will be further elaborated in attempts to design comprehensive public transportation systems for the entire Boston metropolitan area which will serve a wide array of functional goals:

(1) attract the maximum number of auto users
(2) provide improved access to downtown from all areas, particularly those now poorly served
(3) make possible easier lateral or crosstown movement
(4) provide greater possibility for a full, mobile life without dependence on the auto, at least within higher density areas.
(5) provide greater mobility for those who can not drive
(6) improve the equity of the distribution of costs and benefits of the transit system
(7) more effectively integrate parts of the transit system and its linkages with the street arterial and expressway system
(8) make optimal use of emerging innovations in service, operation, marketing, hardware and control systems
(9) place the system on a sounder economic basis.

Rapid transit system design and evaluation work will generally follow the latest techniques developed and applied by MBTA. Environmental, housing, business,joint development design and neighborhood cohesion Study Elements will be integrated with the system design and evaluation work, as with expressways.

Rapid transit route location study will be involved for the improvement and extension of the Orange Line through the Southwest corridor. 12/ Location studies will be required

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12/ Charles Turner, a member of the Steering Group and Working Committee representing the Roxbury community and GBC, has provided fairly detailed suggestion on five specific tasks to be undertaken, one of which deals with the evaluation of alternative locations and types of rapid transit service for the Orange Line,

for major auto-transit transfer facilities on the Alewife Brook Parkway extension of the Red Line in Cambridge, for the Orange Line, the northerly extension of the Blue Line and for bus rapid transit corridors. All work on the Alewife Brook mode-mixer must be closely coordinated with the cooperative planning by MBTA and Cambridge which is in progress on the Red Line extension.

Study Element #7, Special Mobility Studies, will identify and assesses the value attached to greater mobility for all those groups lacking full mobility by automobile: the young, the elderly, the handicapped, the poor, and those housewives and others who do not have autos available, or who cannot drive. Special local transportation needs including transit access will be identified in S.E. #14. To satisfy those needs for which these people and all other Inner City residents will likely realize a value which is estimated to exceed the costs of satisfying the needs, a number of transportation improvements will be considered, analyzed, designed and evaluated as part of the program packages:

(1) Special service to outlying and crosstown job centers for job seekers, and commuters from high unemployment core communities.

(2) Special service to hospitals, clinics, job training centers, community centers and other services of identified need.

(3) Experiments in demand-actuated transit--jitney, dial-a-bus, etc.

(4) Substantial improvements in regular, local service coverage transit by bus and streetcar to downtown, shopping areas and concentrations of employment and other activities, and to serve general crosstown and circumferential movement.

12/ (cont'd) and would therefore be part of this Study Element. It calls for an origin-destination survey of users at existing stations to provide the basis for predicting use, mode of access and quality of service for four alternative transit systems in the Orange Line corridor. See his 10/7/70 writeup in Working Paper file.

(5) Solutions to special local transportation problems which may be identified as part of Study Element #14, Neighborhood Cohesion and Transportation Needs.

The methodology for determining the most appropriate type of service is not standardized or conventional. The analysis will draw on experience gained from recent, related studies in other cities for Model Cities and UMTA's service development demonstrations, as appropriate to the needs and circumstances of Boston, on an interaction with study participants. Where alternative service of the above types may be used to serve special mobility needs identified in S.E. #7, they will be compared in terms of cost, quality of service provided, potential patronage and feasibility of near term implementation. Selected special service demonstration project plans will be prepared.

Various alternatives for coverage transit system improvements (item 4 above) have been identified conceptually by MBTA. 13/ These and perhaps other concepts or revisions to these derived from initial study efforts will be developed into sketch plans during Phase I. Sketch plan design will utilize MBTA and municipal planning staff capabilities and previous staff analyses to the extent possible. Sketch plans for coverage transit will include approximate routes and frequency of service, general type and quality of service (operating speeds, types of vehicle and type of operation) and identification of all major capital and operational changes required to improve speed and efficiency of transit operations. Evaluations will include approximate estimates of increased patronage by neighborhood, increased revenue, value of increased mobility to riders, new equipment requirements, capital and operating costs and changes in subsidy required.

Demand information for use in design and evaluation of coverage transit improvement alternatives will be obtained and combined from the following sources:

(1) Special mobility studies, S.E. #7.

(2) Applications of the demand model in S.E. #6, Land Use and Travel Forecasting.

(3) MBTA ridership data

13/ September 30, 1970 memo by Matthew Coogan of MBTA "Working Paper towards a Definition of 'Coverage Intensive'."

During Phases II and III the results of sketch planning plus more formal traffic forecasting methods will be used to refine and thoroughly evaluate coverage transit improvement alternatives.

A special study will be made of the equitableness of present MBTA fares, subsidies and service provided, as distributed among core communities and suburban areas. To the extent that results show inequitable distribution of costs and revenues, recommendations will be developed for achieving equity.

Arterials, Traffic Engineering and Operational Improvements

The Department of Public Works has recently executed a major, three-year contract with Tippetts-Abbett-McCarthy-Stratton (TAMS), for TOPICS planning, design and evaluation work within selected urban areas of the Commonwealth. A large portion of that work will be performed for municipalities within the Boston Transportation Study area.

As previously indicated, a consensus has been reached by the Steering Group and the Working Committee that substantially increased attention should be devoted to short term, less capital intensive improvements of the type which can be covered by the TOPICS program.

Close coordination of the BTPR and the TAMS work will be maintained. It is anticipated that much, but not all, of the BTPR planning and design work under this heading can be accomplished under the TAMS contract. All Federal requirements for the TOPICS program will be met. 14/

Section V identifies the improvements to be studies as part of the alternative program packages. Many types of improvements are included in all alternatives. The listing below indicates only the types of improvements stressed under each alternative.

Alternative A

- -- Arterial improvements and operational measures oriented toward removing traffic from local streets

- -- Arterial improvements and operational measures

14/ Bureau of Public Roads' Policy and Procedure Memorandum 21-18, May 28, 1970.

to provide adequate access to expressways

-- Arterial improvements and operational measures providing lateral mobility not provided by expressways

-- Operational improvements to speed the flow of transit vehicles

Alternative B

-- Arterial improvements to accommodate truck traffic, encourage routing away from residential areas, and retail centers

-- Traffic engineering improvements designed to provide continuity of flow for internal core traffic and off-peak through movement and to discourage traffic through residential areas, etc.

-- Connections to fringe parking

-- Improvements to accommodate base period (off-peak) traffic not reasonably transferrable to public transportation

-- Improvements to non-core (lateral) highway mobility

-- Improvements to radial arterial movement

-- Operational improvements to speed the flow of transit vehicles

-- Introduction of innovative techniques

Alternative C

-- Arterial improvements and possibly new arterial segments to help replace loss in mobility due to reduction in capacity or elimination of some expressway segments (e.g., South end Bypass, new Charles River crossing, arterial along planned Inner Belt alignment)

-- Operational traffic engineering measures and arterial improvements as covered under Alternative A

STUDY ELEMENT 14

Neighborhood Cohesion and Transportation Needs

The effects of transportation facilities on the neighborhoods through which they pass and serve has become a serious concern. In the past the concern was centered around attempts to provide fair and humane relocation assistance. Recently this concern has been broadened to encompass whole neighborhoods or sections of cities to determine the extent to which the social fabric and neighborhood economic picture is affected. Recent studies such as the Bureau of Public Roads' study measuring highway impacts on the social functioning of neighborhoods are just beginning to yield information useful for transportation policy formulation.

Participants in the Study Design have expressed the strong desire to have this study go beyond the analysis of impacts on neighborhoods by using the results of analyses of neighborhood character, problems and special transportation needs as a basis for designing and evaluating alternative program packages.

A broad objective of this Study Element will be to identify traditionally accepted neighborhoods in the Boston area and to attempt to analyze them with a view toward determining the extent to which alternative transportation facilities can affect (both positively and negatively) various measures of neighborhood liability including:

. . .Degree of social interaction

. . .Neighborhood identity

. . .Specific physical and social symbols

. . .Home-work relationships

. . .Home-shopping relationships

. . .Home-social activity relationships

. . .Pedestrian and local circulation

. . .Parking problems

. . .Affects of through traffic

. . .Access to the transit system

Important inputs will be provided to the design of alternative program packages, at both the route location and more detailed joint development design levels, as well as adding a new level of sophistication to the evaluation of these alternatives. One of the outputs to be used for evaluating all alternatives will be a list of priority transportation improvements from the perspective of neighborhood needs.

The study will also respond to concerns expressed during the study design process as to possible neighborhoodwide impacts during the implementation and construction process. Apart from the overall measures of possible positive and negative impacts on neighborhood functions, specific questions were raised as to a number of specific neighborhood problems, that have occured in the past and should be avoided through more sensitive handling of right-of-way acquisition, property management, demolition and construction.

Phasing and Integration with Other Study Elements

As noted above there will be substantial inputs from these studies into both design and evaluation procedures.

The initial identification of neighborhoods and a preliminary analysis of their internal linkages will occur in Phase I of the study, and will be closely coordinated with the data collection activities described in "Joint Development" (Study Element #5), special mobility studies (Study Element #7, and "Replacement Housing and Family Relocation" (Study Element #12). Data collected will be used to aid the location of major transportation facilities and in the subsequent identification and design of joint development facilities associated with each program package.

The development of evaluation measures, in relation to criteria outlined in Section IV of Part One will also be a major task (see subtask C below).

In common with all other Study Elements, Phase I will involve more general inputs to the design and evaluation of a large number of alternative program packages. As the number of alternatives is reduced correspondingly more detailed evaluation will be required. The majority of basic data collection will be concentrated in Phase I; evaluation tasks will proceed at an increasing level of detail throughout the study, and the development of recommendations for dealing with problems during the implementation period (subtask D) will be related to the preferred program packages emerging in Phases II and III.

Three subtasks are identified below:

A. Inventory and Description of Affected Neighborhoods

Traditionally accepted neighborhoods will be identified and mapped together with evolving neighborhood changes. Data will include brief verbal descriptions of the historic neighborhood basis, ethnic or racial descriptions or changes; degree of social interaction and cohesiveness; and other relevant neighborhood descriptors. Output will be maps and verbal descriptions appropriate for discussion and consensus. Particular emphasis will be given to interviews with local residents, neighborhood leaders, organizations and research into the considerable number of studies and investigations already carried out in the Boston area.

B. Identification of Neighborhood Transportation Needs, Problems and Priorities.

Participants have stressed the fact that many potentially impacted neighborhoods already have one or more of a variety of conditions directly related to transportation which might either be worsened or improved as a result of decisions to be made in this study. Examples include:

(1) shortage of parking for residents making it impractical or excessively expensive to maintain autos;
(2) through traffic not originating or destined within the neighborhood which disrupts social linkages and creates safety problems for pedestrians;
(3) lack of access to the rapid transit system;
(4) poor local transit service
(5) environmental problems, e.g. noise or air pollution caused by highways through the neighborhood
(6) high frequency accident conditions

Information will be collected in each potentially affected neighborhood describing the severity of each of the above and possibly other local transportation problems, their causes and conditions related to possible solutions. Data collection will be coordinated with the special travel needs surveys to be conducted as part of S.E. #7, Special Mobility Studies, as in Subtask A above, full involvement and assistance of local people will be sought.

These data and sources will be used to develop a priority list of transportation needs for each subarea, to be used as input to the design process of S.E. #4 and 5, and also to be used as a basis for evaluation of alternatives as described in S.E. #3.

C. Analysis of the Impacts of Alternative Program Packages on Neighborhoods

Each program package will ne analyzed in terms of the neighborhood structure and transportation needs identified in A and B above and special studies will be initiated in affected neighborhoods to determine physical impacts (important or symbolic buildings lost, etc.), social impacts (barrier effects, extent of relocation, determination of relevant indicators of interaction and cohesiveness, application of indicators as measures, etc.), economic impacts (jobs lost, businesses lost, alternatives, probable changes in neighborhood patterns, etc.) and potential neighborhood gains (needed new facilities provided through joint development, etc.).

Output will be a report encompassing all alternative program packages with attempts to equalize variables and indicators among alternatives, and assign relative weights to both positive and negative benefits.

Specifically, the work will include the development of indicators for the following criteria from Section IV, Part One, as well as refinements that may be defined in early portions of the study:

2. Transportation Service
   L. Change in Travel Time during Construction

3. Safety
   C. Protection during Demolition
   D. Safety during Construction

4. Community Quality
   E. Social and Cultural Impacts

D. Recommendation for Management of Property, Provision of Needed Services, and Maintenance of Community Safety and Integrity During Right of Way Acquisition, Demolition and Construction

A specific concern expressed during the study design process is the host of problems in neighborhoods that are caused by transportation construction and associated activities. This sub-task will recommend a program and special implementation mechanisms for ensuring adequate neighborhood protection in transportation construction and relocation areas.

Work will commence with workshop discussions with neighborhood residents and relocatees from areas formerly or currently involved with transportation facility construction to determine specific concerns and relevant history: analysis of the probable timing of construction in alternate program packages being considered by the study; definition of specific safety and security needs; analysis of current methods of providing security in such areas; determination with affected neighborhood groups, responsible local agencies and the Steering Group and Working Committee of specific new measures to be provided during future transportation facility construction and its associated relocation. Investigation will include possible provision of increased police patrols, publicizing increased security measures, employment of local individuals or groups in various service roles, improved guidelines, procedures and standards for the maintenance and management of property acquired and for the continuing delivery of normal public services, special services to aid residents, provide information and respond to complaints, standards for demolition and construction to minimize disruption of linkages and annoyances from noise, dirt, fumes or vibration, and various mechanisms to create incentives for high maintenance standards by property owners, such as fast writeoffs during the implementation period. Output will be a report on a series of recommended measures, individuals or groups responsible for their provision, and funding sources and procedures.

BUDGET ESTIMATES FOR STUDY ELEMENTS

The following tables contain detailed estimates of professional manpower requirements and costs for each of the Study Elements. These estimates are broken down by study phase as well as by specific subtask as described in the text of Part Two.

At the end of Section III of Part One, a summary budget was presented and discussed. That discussion noted that costs of each Study Element were subject to variation in Phases II and III, within specified ranges, because the precise scope of work for these later phases must depend on results of Phase I -- decisions on selection and elimination of alternatives, the specific nature of program packages being designed, and the relative emphasis that needs to be placed on various criteria in order to facilitate decisions and address concerns responsively.

Budget Estimates for Study Element 1, Study Management

		PHASE I		PHASE II		PHASE III		Totals	
		Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1)	Interaction with Steering Group & Working Committee	2	$ 8	6	$ 24	3	$ 13	11	$ 45
(2)	Participation in Workshops, Briefings, Public Meetings & Informal Interaction	3	13	9	36	5	21	17	70
(3)	Supervision & Coordination of All Staff Work	4.5	18	13	52	8	30	25.5	100
(4)	Coordination with Agencies, Municipalities, etc.	1	4	2	8	2	8	5	20
(5)	Preparation of Reports	1.5	7	5	20	3	13	9.5	40
(6)	Contract Administration	3	10	9	30	5	15	17	55
	Totals	15	$ 60	44	$ 170	26	$ 100	85	$ 330

Budget Estimate for Study Element 2, Community Liaison and Technical Assistance

		PHASE I		PHASE II		PHASE III		Totals	
		Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1)	Community Liaison (subtotals)	(12)	($40)	(28.5)	($95)	(10.5)	($35)	(51)	($170)
	a. Initial Contacts	4.5	15	3	10	1.5	5	9	30
	b. Workshops and Public Meetings	3	10	10.5	35	3	10	16.5	55
	c. Briefings	1.5	5	10.5	35	3	10	15	50
	d. Preparation of Graphics, Press Releases, etc.	3	10	4.5	15	3	10	10.5	35
(2)	Technical Assistance	12	40	33.5	110	9	30	54.5	180
	Totals	24	$ 80	62	$205	19.5	$ 65	105.5	$350

Budget Estimate for Study Element 3, Use of Design and Evaluation Criteria

	PHASE I		PHASE II		PHASE III		Totals	
	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1) Refinement of Criteria	1	$ 4	1	$ 3			2	$ 7
(2) Development of Standards	1.5	5	1	3			2.5	8
(3) Synthesis of Criteria	1.5	5	1.5	6	1	$ 4	4	15
Totals	4	$ 14	3.5	$ 12	1	$ 4	8.5	$ 30

Budget Estimate for Study Element 4, Transportation System Design

	PHASE I Man Mos.	PHASE I Costs (000)	PHASE II Man Mos.	PHASE II Costs (000)	PHASE III Man Mos.	PHASE III Costs (000)	Totals Man Mos.	Totals Costs (000)
(1) Review & Data Collection(A,D2,D3)*	7	$ 22					7	$ 22
(2) Criteria & Standards (C,J)	1	3	1	$ 3			2	6
(3) Interaction with:								
-Steering Group & Working Committee (F,N,R)	1	4	3	11	2	$ 7	6	22
-Workshops (B,D5,E3,H(part),L3, M3,P2,Q(part))	5	19	10.5	37	3	11	18.5	67
(4) Design								
-Expressways (D6,L4,L6)	6	22	48	165			54	187
-Rapid Transit (D7,D8,L5,L7)	7	24	22	72			29	96
-Arterials (D9,L8)	3	10	11	36			14	46
-Local Transit (D10,D11,G,L9,L10,O)	10	34	20	67			30	101
-General & Uncategorized Design Work (D1,D4,D12,H(part),L1,L2,L11, P1,P3)	5	19	19.5	68	13	43	37.5	130
(5) Evaluation (E1,E2,E4,H(part),M1,M2, M4,Q(part))	3.5	13	10	36	3	10	16.5	59
(6) Analysis of Equity of MBTA Fare Structure (K)			3	10			3	10
(7) Final Report (S)					3	14	3	14
Totals	48.5	$170	148	$148	24	$ 85	220.5	$760

* Symbols in parentheses designate items included from more detailed budget table which follows

Study Element 4

Transportation System Design
(Additional Detail)

	Man Mos.	Costs (000)
A. Review of Previous Design Work	1	$ 3
B. Participation in Pre-Design Workshops and Briefings (prime responsibility in S.E. 2)	1	$ 4
C. Participation in Refinement of Criteria, Development of Standards (S.E. 3)	1	$ 3
D. Phase I Sketch Plan Design (subtotals)	(33)	($129)
1. Initial creative, interactive process to develop design principles and establish broad outlines of each sketch design	2	7
2. Field collection of any missing data for design work	2	7
3. Special user surveys at rapid transit stations	4	12
4. Preparation of network descriptions for land use and travel forecasting	1	3
5. Participation in workshops during sketch plan design work (S.E. 2)	2	8
6. Sketch designs for expressways	6	22
7. Sketch designs for rapid transit lines	4	14
8. Sketch designs for mode-mixers	3	10
9. Sketch designs for arterial, traffic engineering and operational measures	3	10
10. Sketch designs for coverage transit improvements	5	17
11. Sketch designs for special transit services for non-mobile groups	3	10
12. Preparation of report on Phase I designs	2	9
E. Evaluation of Sketch Plans (subtotals)	(5.5)	($20)
1. Provision of data for evaluations to be performed as part of other Study Elements	0.5	2
2. Technical evaluation for all criteria for which this Study Element is responsible	2	7
3. Participation in workshops on sketch plan evaluation	2	7
4. Preparation of report on Phase I evaluations (S.E. 3)	1	4
F. Interaction with Steering Group & Working Committee during Process of Reaching Consensus on Elimination, Selection and Refinement of Alternatives	1	$ 4

(continued)

Study Element 4
(Additional Detail, Sheet 2)

	Man Mos.	Costs (000)
G. Preparation of Demonstration Project Plans	2	$ 7
H. Recycle of Sketch Planning for Selected Components as Required	15	$ 50
J. Participation in Refinement of Criteria and Standards (S.E. 3)	1	$ 3
K. Analysis of Equitableness of Present MBTA Fares, Subsidies and Services Provided	3	$ 10
L. Phase II Design Work (subtotals)	(113)	($385)
1. Initial creative, interactive design process	3	11
2. Preparation of detailed network descriptions for land use and travel forecasting	2	7
3. Participation in workshops during design work	6	22
4. Location studies and reports for expressways involving alternative alignments	18	65
5. Location studies and reports for rapid transit lines and mode-mixers	7	22
6. Preliminary design and reports for expressways	30	100
7. Preliminary design and reports for rapid transit lines and mode-mixers	15	50
8. Preparation of plan and report for arterial, traffic engineering and operational improvements	11	36
9. Preparation of coverage transit improvement program and report	15	50
10. Designs for additional special transit services for non-mobile groups as required	3	10
11. Preparation of Phase II design report	3	12
M. Evaluation of Phase II Alternatives (subtotals)	(11)	($39)
1. Provision of data for evaluations to be performed as part of other Study Elements	1	4
2. Technical evaluation for all criteria for which this Study Element is responsible	5	17
3. Participation in Workshops on Phase II plan evaluation	3	10
4. Preparation of report on Phase II evaluations	2	8
N. Interaction with Steering Group and Working Committee during Process of Reaching Consensus on Selection, Refinement and Compromise on Alternatives	3	$ 11

(continued)

Study Element 4
(Additional Detail, Sheet 3)

	Man Mos.	Costs (000)
O. Preparation of Additional Demonstration Project Plans as Required	2	$ 7
P. Phase III Design Work (subtotals)	(15)	($50)
1. Preparation of revised detailed network descriptions as necessary	1	3
2. Participation in Workshops	2	7
3. Preparation of revised designs and reports for components as required	12	40
Q. Evaluation of Phase III Alternatives: (repeat as for Phase II as required)	4	$ 14
R. Interaction with Steering Group and Working Committee during Final Efforts to Reach Consensus on Implementation	2	$ 7
S. Preparation of Part of Final Study Report Covering Above Work	3	$ 14
TOTAL	216.5	$760

Budget Estimate for Study Element 5, Joint Development and the Development of Alternative Program Packages

		PHASE I		PHASE II		PHASE III		Totals	
		Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1)	Reconnaissance & Data Collection	3.5	$ 12	2.5	$ 8	1.5	$ 5	7.5	$ 25
(2)	Identification of Problems and Opportunities	1.5	5	3	10	3	10	7.5	25
(3)	Interaction with Steering Group & Working Committee, Local Workshops and Joint Design	4	15	10	37	5	18	19	70
(4)	Develop & Refine Criteria	1.5	5	3	10			4.5	15
(5)	Develop Program Packages	6	20	50	180	22	75	78	275
(6)	Evaluate Program Packages	3.5	13	8	27	3	10	14.5	50
(7)	Special Studies (as required)			2.5	8	6	20	8.5	28
(8)	Final Report					3	12	3	12
	Totals	20	$ 70	79	$280	43.5	$150	142.5	$500

Budget Estimate for Study Element 6, Land Use and Travel Forecasting

	PHASE I		PHASE II		PHASE III		Totals	
	Computer Costs (000's)	Total Costs (000's)	Comp. Costs (000's)	Total Costs (000's)	Comp. Costs (000's)	Total Costs (000's)	Comp. Costs (000's)	Total Costs (000's)
(1) Land Use Distribution - Adjustment of previous forecasts, sensitivity analysis and judgmentally based forecasts of effects of alternatives	$ 0	$ 15					$ 0	$ 15
(2) Initial Travel Forecasts - Time staged forecasts for 97 zone network	35	160					35	160
(3) Special Studies of Existing Travel, Possible Ranges of Modal Usage & Bottleneck Analysis	6	40					6	40
(4) Land Use/Travel Equilibrium - EMPIRIC runs, runs of x-elasticity demand model & selected link analyses for 97 zone network			$ 10	$ 45	$ 4	$ 15	14	60
(5) Additional Travel Forecasts - x-elasticity demand model runs & assignments + selected link analyses			9	30	3	10	12	40
(6) Detailed 626 zone network assignments to base network	52		52	250			52	250
(7) 1975 detailed forecast & assignment to 626 zone network					44.5	135	44.5	135
Totals	$ 41	$ 215	$ 71	$ 325	$ 51.5	$ 160	$163.5	$ 700

Budget Estimate for Study Element 7, Special Mobility Studies

	PHASE I		PHASE II		PHASE III		Totals	
	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1) Selection of Areas Needing Improved Service	1	$ 3.5					1	$ 3.5
(2) Establishment of Overall Program for Studies	1	3.5	2	$ 7			3	10.5
(3) Design and Execution of Local Surveys	4	13	7	23			11	36
(4) Inputs to the Design of Transport Solutions	1.5	4	1.5	5			3	9
(5) Evaluation of Program Packages	1.5	4	2.5	8	1	$ 4	5	16
Totals	9	$28	13	$ 43	1	$ 4	23	$ 75

Budget Estimate for Study Element 8, Technological Planning

	PHASE I		PHASE II		PHASE III		Totals	
	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1) Literature Review	1	$ 3.5					1	$ 3.5
(2) Analysis of Potential Demand for New Systems	1	3.5	1.5	$ 5			2.5	8.5
(3) Evaluation of Potential Benefits of Introducing New Technologies	1	3	1.5	5	1	$ 3.5	3.5	11.5
(4) Modifications of Designs to Accommodate New Technologies	0.5	2	1	3.5	1	3.5	2.5	9
(5) Assistance in Preparing Demonstration Project Plans			1	3.5	1	4	2	7.5
Totals	3.5	$12	5	$17	3	$11	11.5	$40

Budget Estimate for Study Element 9, Administrative and Legal Studies

	PHASE I		PHASE II		PHASE III		Totals	
	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1) Administrative Cooperation and Delivery Systems	3	$ 10	3	$ 10	3.5	$ 13	9.5	$ 33
(2) Feasibility of Implementation	1	3	3	10	1	3	5	16
(3) Participation Process	1	3	2.5	8	0.5	2	4	13
(4) Review of Legislation	1	4	2	7	2	7	5	18
Totals	6	$ 20	10.5	$ 35	7	$ 25	23.5	$ 80

Budget Estimate for Study Element 10, Environmental and Conservation Studies

	PHASE I		PHASE II		PHASE III		Totals	
	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1) Develop Inputs to Designs	3	$ 10	4	$ 15	2	$ 7	9	$ 32
(2) Collect Data & Review Existing Material	6	18	13	40	3	10	22	68
(3) Evaluation of Alternatives	2	7	4	15	4	15	10	37
(4) Recommend Design Specifications and Implementation			1.5	5	2	8	3.5	13
Totals	11	$ 35	22.5	$ 75	11	$ 40	44.5	$150

Budget Estimate for Study Element 11, Effects of Alternatives on Regional Economy

		PHASE I		PHASE II		PHASE III		Totals	
		Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1)	Economic Overview and Collection of Base Data	1.5	$ 5	1.5	$ 5			3	$ 10
(2)	Analysis of the Impacts of Federal and State Aid Funds	1	3	1.5	5			2.5	8
(3)	Impact on Movement of Goods	1	3	3	10	1	$ 3	5	16
(4)	Analysis of Other Effects on Regional Economy	2	7	5	18	3	10	10	35
(5)	Economic Development Program	0.5	2	0.5	2	2	7	3	11
	Totals	6	$ 20	11.5	$ 40	6	$ 20	23.5	$ 80

Budget Estimate for Study Element 12, Replacement Housing and Family Relocation

		PHASE							
		I		II		III		Totals	
		Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1)	Preliminary Determinations of Relocation Workloads	6.5	$ 20	10.5	$ 35	3	$ 10	20	$ 65
(2)	Preliminary Determination of Replacement Needs	6.5	20	10.5	35	3	10	20	65
(3)	Development of Replacement/Relocation Plans	4.5	15	12.5	41	9	30	26	86
(4)	Analysis of Legal and Administrative Problems	3	10	1.5	4	1.5	5	6	19
	Totals	20.5	$ 65	35	$115	16.5	$ 55	72	$235

Budget Estimate for Study Element 13, Business Relocation and Employment

		PHASE I Man Mos.	PHASE I Costs (000)	PHASE II Man Mos.	PHASE II Costs (000)	PHASE III Man Mos.	PHASE III Costs (000)	Totals Man Mos.	Totals Costs (000)
(1)	Development of Base Data & Preliminary Analysis	4	$ 13	2	$ 7			6	$ 20
(2)	Determination of Displacements	4.5	15	9	30	3.5	$ 12	17	57
(3)	Definition of Local Employment Impacts Associated with Alternatives	2	7	3	10	1	3	6	20
(4)	Business Relocation and Employment Programs	1.5	5	4	13	4.5	15	10	33
	Totals	12	$ 40	18	$ 60	9	$ 30	39	$130

Budget Estimate for Study Element 14, Neighborhood Cohesion and Transportation Needs

		PHASE I		PHASE II		PHASE III		Totals	
		Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)	Man Mos.	Costs (000)
(1)	Inventory & Description of Affected Neighborhoods	0.5	$ 2	1.5	$ 5			2	$ 7
(2)	Identification of Neighborhood Transportation Needs, Problems and Priorities	1	3	1.5	5	0.5	$ 2	3	10
(3)	Analysis of Impacts	1.5	5	1.5	5	1	3	4	13
(4)	Recommendations for Management of Property, Provision of Services, Maintenance of Safety and Integrity During Implementation			1.5	5	1.5	5	3	10
	Totals	3	$ 10	6	$ 20	3	$ 10	12	$ 40

APPENDIX

STATE HOUSE, BOSTON ----- FOLLOWING IS THE COMPLETE TEXT OF GOVERNOR SARGENT'S TRANSPORTATION POLICY ANNOUNCEMENT, WEDNESDAY, FEBRUARY 11, 1970 AT 7:30 P.M.:

I have asked to speak to you tonight to report one of the most far-reaching and significant decisions I have made during my term as Governor.

I have decided to reverse the transportation policy of the Commonwealth of Massachusetts.

The decision has immediate effect on the metropolitan Boston area, long-range effect on the state as a whole, and, it is my hope, major effect on the entire nation.

Last May, I announced a reappraisal of this state's policy on transportation. I asked a special Task Force to conduct that reappraisal and to answer certain questions. Here are the questions --- and the answers.

Are we <u>really</u> meeting our transportation needs by spending most of our money building roads? The answer is no.

Are the roads we <u>are</u> building too costly --- not merely in dollars, but in what they cost us in demolished homes, disrupted communities, dislocated lives, pollution of the air, damage to our environment? The answer is yes --- they are too costly.

The most important question is this: what should we do?

I am here tonight to answer that question --- clearly, plainly, and without doubletalk, for there has been enough of that.

My answer takes the form of local, state, and national decisions.

First, metropolitan Boston. Today construction is planned for several controversial transportation facilities --- all of them highways. Extension of Route 2, the Inner Belt, the Southwest Expressway, and Interstate Route 93 through Charlestown and Somerville.

First, Route 2 and the Inner Belt. Pending today is a five and a half million dollar study of this project. It is called the Task B study and it is scheduled to take 18 months to fix the route of this highway.

I have decided not to approve it. It is too expensive. It would take too long --- and, most important, it would consider only where and how to build expressways, not whether to build them at all.

And that last point is the critical question --- whether to build them at all.

Instead of the Task B study, I have decided on a new approach. I call it the Balanced Transportation Development Program and I will ask approval of it from the United States Department of Transportation.

This program will cost not five and a half, but three and a half million dollars, 90% of which will be federal money. It will operate for 12 months instead of 18. And, most important, its considerations will be far more relevant to our real needs than the Task B study would have been.

This new program will be a first in the nation.

For the first time a metropolitan transportation plan will be developed that is free of outdated ideas and obsolete myths.

The plan will be based on an answer to the question I called critical a moment ago --- not where an expressway should be built, but whether an expressway should be built. It will integrate road-building with mass transit --- and it will study some of these other, imaginative means of moving goods and people: park and ride system, metered traffic on expressways, special bus-lanes, and the host of other space-age approaches now available to the transportation planners.

We must plan for tomorrow, not for yesterday.

My new Balanced Transportation Development Program will also embrace the Southwest Expressway Corridor. The state now owns three-quarters of the land in that Corridor. We are committed to use of that Corridor. Plans now call for highway construction there --- massive highway construction: an eight-lane highway, plus four extra breakdown lanes.

The old plan does call for rapid transit in this Corridor. But it does not consider its proper integration, or other innovative transportation alternatives now available to us. And it emphatically does not consider the impact on the environment --- on housing, on land-use, on people.

I have decided that it must.

My new program will be broad in scope and will consider all aspects of development of a transportation system in the Corridor, for, I repeat, a transportation line must be constructed there.

And, it may well be that a highway will be part of that system.

But before we go further, let us know certainly where we are going, how we are going.

One important footnote. While we consider a new plan for use of the Southwest Corridor, Boston faces a major housing shortage. Today there are 475 livable housing units standing in the Corridor.

I have ordered a halt to their demolition.

The houses and industries not yet acquired by the Commonwealth will not be acquired, unless their owners ask that they be, or unsafe conditions demand that they be.

Those housing units unfit for habitation in the Corridor will be demolished immediately.

I turn now to Route 93. There are those who say all highway construction within Route 128 should stop. They clamor for what they call a moratorium, and they include Route 93 in this unrealistic idea. The result of their proposals would be not a moratorium on construction, but a moratorium on movement within the Route 128 area. I cannot agree to so irresponsible a plan.

I have decided to order the immediate completion of Route 93 from its present terminus in Medford to the proposed link with the Central Artery. That project makes sense. It shall go forward.

It should be clear by now that the Balanced Transportation Development Program I announce tonight is a totally new concept, not only for Massachusetts, but for the nation.

I envision this program altering the nation's transportation thinking for decades to come. It will affect San Francisco and Atlanta as well as Springfield and New Bedford, Worcester and Fall River, Lowell and Lawrence.

Every state, Massachusetts included, is afflicted today by a national transportation policy that is out of date, out of touch with today's realities.

Federal aid to states for transportation today consists mainly of money for highways --- ninety cents on every dollar spent by a state.

But most metropolitan areas need rapid transit systems and federal money for them is skimpy. In the Boston area, as an example, 79 cities and towns must use tax dollars to finance MBTA growth --- and that burden is increasing to unbearable levels.

Further, major federal money for highways, but only minor federal money for mass transit denies cities and towns the right to choose what kind of transportation is best for them. They are left with either building highways or building nothing.

I have decided to do something about that. I will attempt to change national transportation policy. I will go to Congress with these plans to amend federal law.

First, that the Federal Highway Act of 1970 permit states to use Interstate Highway Funds for mass transit systems of all kinds, not just highways.

Second, that that same act permit use of such funds for building and improving arterial streets in cities, not just for expressways.

Third, that that same act permit use of such funds to build houses replacing those demolished for transportation construction. We have in Massachusetts today a good plan for relocating families dispossessed by highway construction. We compensate some. We underwrite rents for others. We protect individuals. But we don't meet community housing needs generally. Last year, Boston built only 109 low income housing units, only 1200 moderate income housing units. Yet the present Southwest Expressway plan would wipe out a thousand units --- with no plan to replace them, no funds to finance a plan.

That doesn't make sense.

And so, I will appeal to Congress. And I will propose an amendment to our own state constitution to permit broader use of our own highway money.

Proposals, of course, are not enough. They must be backed by action.

I shall go to Washington to work for these plans. I shall ask the help of our Congressmen, the help of our Mayors of major American cities, the help of Governors in states with major urban areas.

I shall ask the help of the President of the United States.

Most of all, I shall ask and I shall need <u>your</u> help.

Four years ago, I was the Commissioner of the Department of Public Works --- our road building agency. Then, nearly everyone was sure highways were the only answer to transportation problems for years to come.

We were wrong.

Today we know more clearly what our real needs are --- what our environment means to us --- what a community means to us --- what is valuable to us as a people.

Today I know, as Governor of this state, that the errors of the past will cost us dearly if we do not correct them immediately.

We must move quickly.

I mean to do so. Thank you.

BIBLIOGRAPHY*

(PART ONE)

Boston Redevelopment Authority (BRA)

BRA. The Lab is the City: A Proposal to Develop a Central Area Distribution System, May 1968.

BRA. Transportation Facts for the Boston Region, 1968-1969 Edition.

Boston Regional Planning Project

Boston Regional Planning Project. Comprehensive Traffic and Transportation Inventory, prepared by Wilbur Smith & Associates, 1965.

Eastern Massachusetts Regional Planning Project (EMRPP)

EMRPP. The Development of a Travel Forecasting Model, prepared by the Massachusetts Department of Public Works (DPW) in conjunction with the Massachusetts Department of Commerce and Development, the Metropolitan Area Planning Council (MAPC) and the Massachusetts Bay Transportation Authority (MBTA), February 1969.

EMRPP. A Guide for Improvements in Traffic Performance, prepared by DPW, July 1968.

EMRPP. Guides for Progress: Development Opportunities for Metropolitan Boston, prepared by MAPC with the Department of Commerce and Development, DPW and MBTA, April 1968.

EMRPP. Parking: A Regional View, prepared by DPW with the Department of Commerce and Development, MBTA and MAPC, March 1969.

EMRPP. Recommended Highway and Transit Plan, prepared by DPW and MBTA, 1968.

Governor's Task Force on Transportation

Governor's Task Force on Transportation. "Report to Governor Sargent," Parts I and II, January 1970 and June 1970.

* Materials are grouped in three ways: by issuing authority (Boston Redevelopment Authority); by general classification (Federal Legislation); and by special subject (Cambridge Inner Belt).

Massachusetts Bay Transportation Authority (MBTA)

MBTA. "Budget Data and Transit Facts," MBTA Board of Directors, 1969-1970 Issue.

MBTA. "Cass Report," Volumes I and II.

MBTA. Comparison of Vehicular Transit Systems in the Greater Boston Area, prepared by Gibbs & Hill, Inc., 1965.

MBTA. Foster, C.D. and Neuberger, H. Manual for the Social Evaluation of Projects in the MBTA, Revised July 1970.

MBTA. "Request for Added Funds," report to the Joint Committee on Transportation, July 1969.

MBTA. Revised Program for Mass Transportation, January 1969.

MBTA. "Special Commission to Study Finances and Operations of MBTA," Interim Report, December 1969.

Massachusetts Department of Public Works (DPW)

DPW. Inner Belt and Expressway System, 1962.

DPW. Basic Design Report: Inner Belt Expressway (Cambridge & Somerville), prepared by Goodkind & O'Dea, Inc., 1965.

DPW. I-695: Inner Belt Highway, Boston, Cambridge & Somerville: Location Restudy, prepared by H.W. Lochner, Inc., May 1967.

DPW. Report on Engineering and Architectural Elements: Inner Belt, Interstate 95 (Roxbury), 1967.

DPW. Basic Design Report: Interstate 95 Boston (Charlestown), prepared by Fay, Spofford & Thorndike and Charles A. Maguire & Associates, 1965.

DPW. Basic Design Report: Southwest Expressway Interstate 95, Route 128 (Canton to Jackson Square, Boston), prepared by Brown Professional Engineers, Inc., 1966.

DPW. Basic Design Report: Interstate 95, Saugus, Lynn, Peabody, prepared by E. Lionel Pavlo Engineering Co., October 1965.

DPW. Basic Design Report: Relocated Route 2 (Arlington-Cambridge-Somerville), prepared by Universal Engineering Corporation, 1968.

DPW - Joint Board for the Metropolitan Master Highway Plan. The Master Plan for the Boston Metropolitan Area, prepared by Charles A. Maguire and Associates with DeLeuw, Cather and Company and J.E. Greiner Company, February 1948.

The TAMS contract specifies all of the engineering and physical inventory data which must be collected regarding the existing arterial and street system and its operation. Additional information not specifically called for in the TAMS contract, but necessary for planning the type of improvements listed above will include:

(1) Traffic forecasts to determine the changes which are expected in patterns of traffic as a result of the alternatives being studied--from S.E. #6, Land Use and Travel Forecasting, and previous forecasts of EMRPP and Task A.

(2) Information on pedestrian linkages, neighborhood cohesion and the degree to which traffic in neighborhoods is disruptive--from S.E. #5, Joint Development, and #14, Neighborhood Cohesion and Transportation Needs.

(3) Information on coverage transit improvement plans and other design work being prepared as part of this Study Element.

Preliminary TOPICS planning will be undertaken for all heavily congested corridors in the core area as part of Phase I. This planning work will be continued in Phase II in full depth for all areas for which Phase I yields positive results and for which the Steering Group and Working Committee agree work should proceed.

TOPICS planning work will place heavy emphasis on the facilitation of local service transit movement through such measures as provision of separate rights-of-way, separate lanes, special ramps, transit activated signals, terminals and shelters. Heavy emphasis will also be placed on pedestrian safety and amenities.

All promising innovative schemes for increasing the efficiency, capacity and safety of existing arterials and expressways will be studied including ramp metering and pacing of traffic to assist merging, use of bus only, mixed bus-car pool, or bus plus metered auto access lanes, and computer controlled, demand actuated, areawide signal systems.

TOPICS plans will be developed for selected core area communities heavily impacted by truck and auto traffic traversing residential neighborhoods and community shopping and service areas. These plans will be designed to discourage through traffic and route it around such areas.

It is anticipated that the majority of the above work can be accomplished under the TAMS contract. However, many aspects of the above work, including the use of additional data sources, the iterative process, the emphasis on improvement of transit movements, and the study of a wide range of alternatives with differing emphasis on TOPICS-type improvements, were not contemplated in TAMS' work to include all required additional work, assuming that the efforts are fully integrated.

Summary Listing of Tasks

. . .Review of previous design work

. . .Participation in pre-design workshops and briefings (prime responsibility in S.E. #2)

. . .Participation in refinement of criteria, development of standards (S.E. #3)

. . .Phase I Sketch Plan Design:

--Initial creative, interactive process to develop design principles and establish broad outlines of each sketch design
--Field collection of any missing data for design work
--Special user surveys at rapid transit stations
--Preparation of network descriptions for land use and travel forecasting
--Participation in workshops during sketch plan design work (S.E. #2)
--Sketch designs for expressways
--Sketch designs for rapid transit lines
--Sketch designs for mode-mixers
--Sketch designs for arterial, traffic engineering and operational improvements
--Sketch designs for coverage transit improvements
--Sketch designs for special transit services for non-mobile groups
--Preparation of report on Phase I designs

. . .Evaluation of Sketch Plans

--Provision of data for evaluations to be performed as part of other Study Elements
--Technical evaluation for all criteria for which this Study Element is responsible
--Participation in workshops on sketch plan evaluation
--Preparation of report on Phase I evaluations (S.E. #3)

. . .Interaction with Steering Group and Working Committee during process of reaching consensus on eliminating, selection and refinement of alternatives

. . .Preparation of demonstration project plans

. . .Recycle of sketch planning for selected components as required

. . .Participation in refinement of criteria and standards (S.E. #3)

. . .Analysis of equitableness of present MBTA fares, subsidies and services provided

. . .Phase II Design Work:

--Initial creative, interactive design process
--Preparation of detailed network descriptions for land use and travel forecasting
--Participation in workshops during design work
--Location studies and reports for expressways involving alternative alignments
--Location studies and reports for rapid transit lines and mode mixers
--Preliminary design and reports for expressways
--Preliminary design and reports for rapid transit lines and mode mixers
--Preparation of plan and report for arterial, traffic engineering and operational improvements
--Preparation of coverage transit improvement program and report
--Designs for additional special transit services for non-mobile groups as required
--Preparation of Phase II design report

. . .Evaluation of Phase II alternatives:

--Provision of data for evaluations to be performed as part of other S.E.'s
--Technical evaluation for all criteria for which this S.E. is responsible
--Participation in Workshops on Phase II plan evaluation
--Preparation of report on Phase II evaluations

. . .Interaction with Steering Group and Working Committee during process of reaching consensus on selection, refinement and compromise on alternatives

. . .Preparation of additional demonstration project plans as required

. . .Phase III Design Work:

--Preparation of revised detailed network descriptions as necessary
--Participation in Workshops
--Preparation of revised designs and reports for components as required

. . .Evaluation on Phase III alternatives:

--(repeat as for Phase II as required)

. . .Interaction with Steering Group and Working Committee during final efforts to reach consensus on implementation

. . .Preparation of part of final study report covering above work

Specific Results to be Obtained

By way of summary, plans of the following type are to be provided by this Study Element:

(1) Preliminary designs (see above text for definition of level of detail included) for all expressways and rapid transit lines within route 128, including horizontal and vertical alignment, type, size and location of all major structures.

(2) An areawide TOPICS plan identifying priorities for arterial, traffic engineering and operational improvements (majority of work to be accomplished under TAMS contract--see above texts).

(3) A coverage transit improvement program including routes, schedules, equipment and traffic engineering improvements.

(4) Demonstration project plans for special transit services for non-mobile groups and for other innovative transit services and traffic operations.

Evaluations to be made as part of this Study Element will produce data on the criteria listed below (described more fully in Section IV), subject to amplification and refinement during the study: All criteria of Section IV are to be used. Those not listed below are covered in other Study Elements.

1. Economy

   A. Costs of Highway, Transit and Traffic Engineering Improvements
      (2) Standard construction cost items. . .
      (16) Capital costs for new equipment (vehicles, traffic signals, operation control centers).
      (17) Capital costs of additional private vehicles to compensate for any reduction in level of service.

   C. Total Costs--net change in total operating, maintenance and capital costs, by each system type, for the entire package of changed transportation facilities.

2. Transportation Service

   B. Frequency of service, travel times, and price of service to the users.

      (1) Peak hour service levels, times and costs.
      (2) Non-peak hour service levels, times and costs.

   E. Convenience, comfort, aesthetics, effects of congestion, and other qualitative aspects from the point of view of the user.

   G. Integration and coordination between the various service elements.

   H. Clarity of the transportation pattern, informativeness, variety, and stimulation provided to the user.

   I. Ease of boarding and deboarding, especially for the elderly , the disabled, and the young.

   K. Privacy or participation.

   N. Ease and convenience of handling packages.

   O. Convenience for goods movement

5. Acceptability and Adaptibility

A. Possibilities for timely coordination with other transportation systems, such as inter-city transport.

E. Effects on leaving open or closing future options and causing or not causing irreversible change.

STUDY ELEMENT 5

Joint Development and the Development of Alternative Program Packages

The objective of the joint development activity outlined here is two-fold. The most important function is that of integrating transportation and non-transportation elements into definable program packages for evaluation, selection and implementation. A second function involves certain specific activities relating to the identification of local community issues and opportunities and the design of components of program packages unique to this Study Element.

Joint development is a realtively new concept as it is associated with the planning, design and construction of transportation facilities. The concept had its beginnings and its initial development in the past few years in association with development of highways which already were well along in the planning process.

There have been at least two major joint development studies proposed in the Boston metropolitan area, one associated with the south west corridor, the other, which was never started associated with the Inner Belt through Cambridge (Task B). The Study Element described here has been defined in the light of experience gained in the planning of these previous studies, even though it is part of a substantially different and more comprehensive transportation planning process. That experience has led to decisions to: (a) develop the level of detail for each alternative to be tested only to a point consistent with the phase of evaluation (sketch plans for Phase I and more detailed designs for later phases as the number of alternatives are reduced); (b) to create mechanisms for the continuous involvement of private groups who will be the eventual "users" of joint development projects; and (c) to place emphasis on assuring implementation of projects developed during the design process.

The development of the transportation system components will be performed mainly under Study Elements 4,6,7 & 8. The location of the major transportation facility routes, the sketch design (in Phase I) and preliminary engineering (in Phases II and III) together with appropriate design work associated with joint development projects and the integration of inputs from other study activities will be achieved in this Study Element.

Certain Study Elements, Environmental Studies (S.E. #10); Family Relocation and Replacement Housing (S.E. #12); Business

Relocation and Employment (S.E. #13); and Neighborhood Cohesion and Transportation needs (S.E. #14) will all have very substantial inputs into both the design and evaluation of the program packages defined in this part of the study.

The identification of joint development actions will derive from two main sources:

1. Those actions needed to compensate for, or mitigate the negative environmental, social and economic impacts of the proposed transportation facility.

2. The opportunities for land uses, activities, and development brought about by increased access, the construction of "mode mixer" complexes, the location of stations, interchanges and so forth.

As far as feasible, the transportation and related joint development elements of the program packages will be developed simultaneously.

As outlined in Section III of Part One, the study plan calls for three phases of design, evaluation and decision making.

In Phase I of the evaluation process, the summary analysis of the impact of the proposed transportation facilities and related joint development activities, will be based on available published data and qualitative judgment of the professional staff supplemented by that of affected communities, and participants in the Working Committee.

In Phase I, the related joint development projects will be treated as preliminary sketch designs developed to sufficient detail to enable meaningful interaction with participants. Approximate cost estimates, and preliminary marketability forecasts will be made.

In the succeeding phases considerably more detailed plans and preliminary designs will be developed with correspondingly more rigorous evaluation procedures applied.

Tasks to be Accomplished

Plans will be developed for integrating each proposed transportation facility with potential joint-use facilities in the subareas. These plans will be based on a reconnaissance of the subareas, collection of data and an evaluation of the problems and opportunities including full input from private groups.

Existing data will be utilized to the maximum extent possible, but much of the necessary data will be generated by the more specialized transportation impact Study Elements listed above. A high degree of integration will be necessary among these study activities.

The major tasks are described below:

1. Reconnaissance and Collection of Data

The description and analysis of the areas shall consist of the collection and assimilation of data and information from subarea groups outlining existing conditions and programs for the future of various specific neighborhoods directly affected by the proposed major transportation facilities--expressways and rapid transit lines.

The plans and programs to be examined include urban renewal projects of the BRA, CRA, BHA, Model Cities Programs, projects and plans of the Board of Education, plans of universities and plans and programs of other public agencies and private organizations to be identified during the reconnaissance.

Both quantitative and qualitative information, as well as identification of private groups will be developed in workshops. The workshops also will generate early ideas and proposals for development in the interative process.

Pertinent data in statistical form as well as qualitative information will be developed to provide a planning base, including population, social, and economic factors necessary to understand principal forces, trends and needs for areas and neighborhoods impacted industrial transportation requirements, residential characteristics, acoustic and air quality characteristics and existing economic parameters.

a. Description of areas of major impact--

The Study team, with assistance from the neighborhood groups shall define the study area with special reference to natural features, topography, man-made facilities, and environmental attributes.

Survey and documentation of predominant land use and exterior building condition shall be provided from existing sources, and material developed in related study activities. Included

will be centers of neighborhood activity such as shopping, recreational, institutional, and unique features as well as major routes of movements.

b. Description of Neighborhoods and Sub-regions--

Residential, commercial and industrial sub-areas and recreational, community and open space facilities will be analyzed and described drawing on material from related study activity. Plans and programs, needs and deficiencies and access requirements shall be assembled for these sub-areas.

c. Description of Activities, Resources, On-going, Programs and Plans of Organizations and Agencies--

An analysis and description of on-going programs and activities, appropriate resources and relevant plans (including scheduling) of organizations, individuals and agencies involved in the environs of the transportation facility.

2. Identification of Problems and Opportunities--

An analysis and evaluation of the physical, social, economic, functional and environmental characteristics of the subarea adjacent to and including the transportation facility will focus on specific community problems and opportunities.

Key issues affecting the redevelopment of the transportation corridor will be specifically identified. Social, economic, political and physical development issues will be considered, the inter-relationship between issues will be examined, and the role of key persons and organizations will be described. The analysis will integrate material developed in related study activities dealing with neighborhood improvement, education, employment and retraining, economic development, recreation and other related concerns. Alternative directions for resolving key issues will be presented to the Steering Group and Working Committee.

3. Initial Plans--

A wide range of initial planning strategies for the corridor together with its urban setting will be developed during the Phase I for each major transportation alternative.

As the work proceeds through the Phase I evaluation, strategies with less validity will be discontinued.

a. Planning Framework

Planning objectives and strategies for the program packages will be developed which integrate the various areas of concern for the development of a potential corridor. This analysis of alternative possibilities will provide:

(1) A description of the development pressures apt to occur within the subarea with or without construction of a new transport facility and the relationship of those pressures to locally defined problems, goals and objectives.

(2) A listing of those actions needed to adjust and restore interrupted transportation, economic and social patterns to an acceptable level, with a recommended assignment of responsibilities.

(3) Descriptions of ways the plans and programs of local private groups and political jurisdictions might be beneficially combined in the planning process.

b. Plans for Components of Subarea Development--

Alternative plans will be developed for joint development projects associated with the transportation facility, and for the adjacent impacted subarea.

(1) Joint and Collateral Development

A series of proposals will be developed to accomplish the objectives specified in the planning framework through joint and collateral development. These proposals will be based on an identification of area needs and deficiencies, replacement facility needs, and marked demands for economic activities in the areas, and from the information flowing from other Study Elements. Concentration will be on joint development proposals. Workshops and interaction between study staff and affected private groups will take place to establish citizen input in the design and review of joint development proposals as they are being developed.

(2) Market Studies--

In conjunction with tasks specified in Study Elements #10,12 and #13 specific market studies will be conducted at a local special area level to determine the market feasibility of joint development projects. Initial activity will focus on determining the potential demand for various types of development: residential, commercial, etc., relative to specific ideas or proposals and in conjunction with the design of the transportation facility. As joint development projects become more defined the emphasis will shift to examination of specific sites and designs in terms of financial feasibility and the definition of appropriate development mechanisms.

(3) Circulation--

A series of proposals will be produced to illustrate alternative design treatments for the integration of the proposed transportation facility with local circulation patterns, including public and private vehicles and pedestrian traffic. Plans will be prepared at the appropriate scale showing recommended improvements of streets, parking, pedestrian network and public transportation facilities.

c. Institutional Structure for Implementation of Program Packages (see also S.E. #9)

Recommendations will be developed for implementation of program packages with appropriate responsibilities assigned to State and municipal agencies, private groups, community development corporations and commercial developers. Interrelationships and an organizational structure for the cooperation and collaboration between public agencies and private groups and individuals will be described. In collaboration with the activities described in Study Element #9, Administrative and Legislative Studies a review of State and Federal legislative, regulatory, and administrative constraints on joint development implementation will be carried out. This review will serve as a

basis for preparing recommendations for administrative and legislative changes as appropriate for the implementation of projects designed to mitigate the negative impact of transportation facilities.

In addition to these tasks, this Study Element encompasses the evaluation of the alternatives against the following criteria from Section IV of Part One:

1. Economy

   A. Costs of Highway, Transit and Traffic Engineering Improvements.

      (2) Construction Costs
      (3) Auxiliary Facilities
      (4) Replacement Facilities
      (7) Construction for Non-relocated Property
      (8) Loss of Value
      (11) Operating Costs of Cities and Towns
      (13) Continuing Services

2. Transportation Service

   J. Net Change in Travel to non-users (pedestrians)

3. Safety

   C. Protection During Demolition
   D. Safety During Construction
   E. Convenience During Construction

4. Community Quality

   F. Development Opportunities (1-3)
   G. Effect on Community Strength & Growth (1-3)
   H. Visual Characteristics (1-6)

5. Acceptability and Adaptability

   B. Adaptability to Social Environmental Programs

6. Distributional Effects

   B. Land Use Distributional Effects (1-2)

STUDY ELEMENT 6

Land Use and Travel Forecasting

The objective of this Study Element is to forecast land use 1/ and travel patterns to the required degree of disaggregation of small areas, modes, links and time of day, to the accuracy required for deciding between alternative transportation program packages, and to provide evaluations of two basic types:

(1) assessment of the degree to which each alternative furthers regional land development objectives, and

(2) assessment of user costs and benefits.

The work defined here is essential to the evaluation of alternative transportation systems. The assessment of the primary direct benefits of, and therefore the primary justification for, transportation investment -- user time, cost and operating savings -- can be determined in any meaningful way only through the type of work described here. A large proportion of the other benefits and costs, particularly environmental effects, are direct functions of traffic volumes and conditions, and therefore dependent on this work.

All of the work described here is necessary, despite the large amount of land use and travel forecasting work accomplished in recent years, because most of the alternatives being considered have not previously been subjected to analysis and evaluation. The new work builds heavily on that past work, however, and because it does, can be accomplished at a small fraction of the time and cost that would otherwise be required.

The alternatives being studied include a wide variety of different assumptions about speed, price, frequency and con-

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1/ The term "land use" as used here refers to the spatial distribution of activity. It is measured in terms of the amount of population and employment by major category of industry within the various subareas of the metropolitan region. Land use does not refer to specific uses of particular parcels of land. The finest level of detail dealt with in analyses and forecasts will generally be summary measures of population by four income ranges, employment by five categories, density measures, and total land used by category for subareas ranging in size from about that of census tracts to towns.

venience of travel service. The design and evaluation criteria which have been proposed for deciding between program packages relate to a very wide set of important issues facing our urban areas. The challenge has been to structure and carry out forecasts of land uses and travel in a way that is sensitive to the differences among alternatives, the values and criteria generated by the participants in the study process, and sensitive to the need for staged decision making in which several iterations of analyses are needed for comparing alternatives over the period of the study. Because of the use of substantially different methods in this study, and because of the need for understanding of the proposed work by participants with widely varying backgrounds, a rather full explanation of the approach and methodology is presented below before the specific work program is described in the final subsection of this Study Element.

Approach

A. Use of Forecasts and the Need for Computer Models

Travel forecasts relate to a large proportion of the design and evaluation criteria proposed by study participants. Travel forecasts characterize or determine the quality of the system performance, the benefits stemming from travel, the resources expended for such movement by users and society, the external effects resulting from such travel, and the incidence of the benefits and costs.

In turn, the necessity for explicit sensitivity on the part of the forecasts to the wide range of program packages and evaluation criteria proposed, imposes rigorous requirements on the forecasting methodology. These requirements relate to many aspects of the forecasts including their detail, accuracy and reproduceability.

Land use and travel demand models attempt to provide schematic and simplified quantitative descriptions of land use (activity) and travel behavior patterns as they occur in the real world. In ideal terms, the models describe the interrelationships among variables which may change in the future, which are predictable (at least within certain limits), and which influence the demand for or performance of the system. The models describe the causal relationships between socio-economic and transport system characteristics, on the one hand, and activity patterns and tripmaking, on the other.

Most, if not all, land use and travel forecasting models fall short of this ideal in certain respects. Nevertheless, it is often quite justified from a cost saving viewpoint to use simpler models which involve limiting assumptions, as long as the

assumptions are stated and can be judged not to render misleading results.

Not all models require the use of the computer. There are several reasons for using computer models in a transportation study. Computer models force the user to state in clear and objective detail the impacts to be forecast, the conditions (input data) under which the forecast is to be made, and the relationships between the two. The results of the forecasts are reproduceable and can be checked by objective third parties if necessary. Also, the explicit statements which the computer models require can help communicate between all parties just what is being tested and under what circumstances the test is made.

But the most important reason for using computers is the great complexity of the transportation system with all its variables and interactions in time and space with the larger urban system. The forecasts result, for example, in flows of people between parts of the region. The number of flows is equal to the square of the number of parts of the region being considered. In addition, in order to "assign" flows to links of the transportation network, the "parts" of the region have to be small so that only traffic from the appropriate "feeder area" gets assigned unambiguously to the proper series of transportation links in the network. In addition, the number of trips, and in general the trip making behavior of travelers, varies with a large number of social and economic characteristics of the travelers, the activities at their destinations, and the characteristics of the transportation system in between. This means the region must be subdivided into areas which are again relatively small, in order to detect the socio-economic and transportation service differences between areas. The result is that the region must be divided into too many subareas and flows between subareas to handle by manual means. Computer models are required if travel is to be forecast at all.

B. Appropriate Complexity of Method

The degree to which complex methodology should be employed rests on several factors. Among these are:

- . . .the importance of the finding or set of related findings in decision making;
- . . .the amount which additional expenditure on methodology contributes to decreasing the uncertainty of findings;
- . . .the sensitivity of the final decisions to uncertainty in the findings; and
- . . .the required detail or elaboration needed to make the findings relevant or useful.

Forecasting activities must be planned carefully because the application of complex methodology in land use and travel forecasting can be very expensive. Important considerations, conclusions and strategy for this study with regard to each of the above factors are discussed in the paragraphs which follow:

1. Importance and Sensitivity of Findings

The design of a study must always proceed without complete knowledge of the relative importance of all of the design and evaluation criteria relating to the benefits stemming from travel, the costs of such travel, the quality of the system performance, and the measures of each of these which must be used to forecast the external effects of the land use arrangements and travel conditions, etc.

Despite this lack of knowledge of the relative importance of the various criteria, certain statements can be made which give perspective to the information required from the land use and travel forecasts:

(1) A great deal of stress has been given to the need to determine whether the investments are warranted--that is, do the benefits (to passengers, people moving goods and others) for a proposed system outweigh the total social and economic costs of building the system?

(2) How do the several alternative ways of improving the transportation system compare in terms of benefits and costs?

(3) How equitably are the benefits and costs distributed among communities, users and non-users and among various classes of users?

(4) The need for the methods to produce the detailed data required for design of transportation facilities is recognized, but that need follows in time the need to answer the above questions, and this level of detail is not required for all alternatives being studied.

Highly technical points must be explored to assess the level of uncertainty associated with any finding from a given expenditure on methodology. The science of analyzing errors in output from complex techniques involving computer manipulation of large data files is in its infancy.

Expensive and time consuming research would be required to adequately assess the degree to which uncertainty of forecasts could be reduced through improvements to available forecasting methods. Such research is unwarranted in this study.

Because of the limiting assumptions inherent in conventional methods, and for other reasons, it is clear, however, that the amount of error that can be reduced by improvement of conventional methods is small. The reduction of uncertainty becomes smaller and highly questionable as the complexity of these methods is pushed beyond the range of current practice.

For these reasons, the recommended strategy is to reduce error by employing alternative techniques in parallel in their most simplified form, rather than face the uncertainties of pushing one technique very far. The strategy to be described more fully later includes building relatively quickly and cheaply on the results of previous conventional travel forecasts, and employing newer, more powerful and internally consistent policy sensitive demand models to accomplish what can not reasonably be done with conventional models because of cost and inherent limiting assumptions.

The sensitivity of decisions on program packages to uncertainty in the findings is a function of many factors. These include the evaluation framework, the range of actions (program packages) being analyzed, and the flexibility of the program packages to serve "equally" well in a number of different situations. Flexibility is itself an important selection criterion as will be discussed later.

Tests of flexibility to serve uncertain futures must be an important part of this study. They will include sensitivity analyses carried out in simple fashion where one variable is changed in an analytically solvable framework. In other cases, the sensitivity analyses will require repeating computer travel forecasts with critical input uncertainties such as levels and distribution of core area population and employment.

2. Scale and Detail Necessary for the Study

Planning and decision making take place at many scales, from the regional systems level to the fine grained neighborhood level. Each level of planning imposes certain requirements as to the required detail of land use and travel forecasts.

The present conventional travel forecasting techniques attempt to satisfy all requirements simultaneously. The techniques are designed to be applied at the regional systems level, and to output detailed information for engineering design purposes (e.g., highway link and ramp volumes). In this process, the conventional computer models fail badly at analyzing transportation needs at the neighborhood level, particularly of groups whose travel characteristics don't conform to regional averages. The computer models have proven most successful at evaluating the general consequences of networks rather than the operational details of particular facilities or interchanges.

An MDC participant aptly warned against getting involved with the wrong detail in the methods used, and that conventional network analysis imposes detail which may not be the most important detail. The analyses need be designed to provide only that level of detail required at a given stage of evaluation and decision making. This means that large changes in the regional scale expressway network being tested for achievement of system related and metropolitan goals (e.g., regional systems effects on traffic and land use patterns throughout the region), can be tested at a high level of aggregation (i.e. less detail).

Particular program packages tied to major decisions will be analyzed at successive levels of detail as appropriate to the planning decisions at hand: regional decisions at a high level of aggregation of forecasts; neighborhood decisions involving defined alternatives at a fine level of detail.

Several iterations of analyses will be required. The first will involve a coarser level of analysis in the use of traffic forecasting models, will use only those formal techniques which are capable of rapid execution in Phase I of the Study, and will rely on judgment and manual techniques for part of the work (land use forecasts and special fine-grained traffic problems or "bottleneck analysis").

Finally, the emphasis and detail given to the development of the transportation improvement should vary with the time horizon of the project. A project calling for immediate decisions is operationally, politically and economically (due to discounting and uncertainty) more demanding of detail than a project to be built 10 or 20 years in the future. This does not diminish the

importance of testing full alternative transportation systems at some long range target year (at a lower level of detail) to test for achievement of system related and metropolitan goals. But the increased attention and therefore needed detail, that results from the high interest of participants on near term projects should be recognized and responded to.

3. Rapid Narrowing of Alternatives

Simplified analyses at a relatively high level of aggregation of alternative program packages are necessary early in the Study to help narrow the number of alternatives being considered. The analytical methods must be designed for rapid execution to permit testing or revised sketch plans if necessary, and to move quickly to the choice of alternatives for detailed testing.

The methods proposed for use in the sketch planning analyses in Phase I are:

(1) For land use forecasting, the best informed judgment of professional staff using in part the results of the substantial previous regional scale forecasting work, and interpreting those results to assess the consequences of the new alternative program packages. Any differing opinions would be reported, together with their rationale.

(2) The use of a new model for forecasting traffic which has the dual advantage of greater simplicity of use and the ability to take into account certain relationships which conventional methods ignore, but which are important in this Study because of the wide variation in alternatives being tested. In Phase I, the forecasts can be carried out only at a high level of aggregation, testing for important differences in travel and land use patterns due to regionally important differences in transportation policies (e.g., presence or absence of expressways, coverage versus speed intensive transit, various arterial street improvement policies, etc.).

(3) The best informed professional judgment, and shortcut analytic methods will be used to assess the consequences of fine-grained differences ("bottleneck analysis") in program packages at

the neighborhood level, using the results of traffic assignments from (2) above. In part, alternatives can be chosen for detailed testing which are hypothesized to cause significant differences in impacts at the neighborhood level. In this way, more informed judgments may be made as to the impacts of small changes in the alternatives.

The above three methods carry out in Phase I of the Study what the MDC recommended in their memo on methodology of September 8, 1970. Referring to highways, the MDC stated:

> "During the restudy, analysis should proceed from general traffic and land use forecasting to a network model, and then to a congestion and bottleneck analysis which would take proper account of consequent induced commuter flows."

Conventional land use and travel forecasting methods cannot be applied in so short a period as that available for the initial narrowing of alternatives. Also, it is not clear they should be applied for purposes of an initial test of wide variations in alternative transportation policies. Their sensitivity to alternative policies is limited, and their lengthy computational requirements makes their application time consuming and costly. They are best applied where the detail of information which they supply is useful to decide between a limited number of alternatives, and to improve professional judgments as to the impacts of additional small changes in the alternatives. The conventional models will also provide a check on initial methods to reduce the uncertainty of the findings of all the technical analyses, as discussed previously.

It is felt that this approach, which substitutes the use of a new rapid-operating, policy sensitive computer model in place of cumbersome conventional computer models, will enable maximum understanding by all groups of the impacts of widely differing alternative transportation program packages. The specific manner of use of all techniques is described in the final subsection, "Work Program", of this Study Element.

C. Need for Design Ability

Transportation planning should involve continual interaction between the design of alternatives and the process of selection (i.e. prediction, evaluation and decision making). The selection process should continually generate new information on the consequences of alternatives, and the study participants' values, preferences and priorities. The information generated for narrowing the number of alternative program packages is the same as that needed in the first place for design purposes.

The need for allowing synthesis and redesign has been recognized by study participants. In the words of the Municipal Caucus memorandum of September 9, 1970:

> "All . . . alternatives would be subjected to preliminary evaluation by short cut methods. Some would be dropped, others might be carried forward substantially unchanged and still others would be combined and adjusted before being carried forward for further analysis. It is possible that one or more substantially new alternatives would be developed."

The challenge is to structure the analysis process to allow the added information from prediction and evaluation to feed back to the design and redesign of alternatives, and to insure that this feedback does not become endless.

From the standpoint of travel demand, the goal is to design transportation systems in accordance with travelers' preferences for alternative service improvements. This goal is clearly only one of many by which transportation system improvements are evaluated. Responding to this goal includes:

1. Gaining a good understanding of existing travel in the region. The travel baseline may be obtained in many ways. One way is to map in understandable form the existing travel in the region by mode and mode combinations, purpose, and time period. The maps would show travel in one and two dimensions ("trip ends" and "trip interchanges", respectively) for small areas of the region.

2. Equally important is to gain an understanding of trips not made, and why. This calls for analyses and displays at the regional, small area and trip interchange levels of trips made by different groups and between different parts of the region. Attempts would be made to understand

the differences in trip making by rich and poor, black and white, car and non-car owning, transit served and non-transit served, etc; and to relate these differences to proposed system improvements to gain a better understanding of how well, in general, the changes will serve different areas and groups.

3. The function of each major link in the transportation network needs to be better understood. This would require an "assignment" of the existing universe of travel, perhaps by trip purpose. A special summation and display ("selected link output") would be made of the origins and destinations of travel, and the quality of travel service on each major link.

4. There is need for a basic description of the way transportation network price and service alterations affect movement patterns by mode, purpose and time period in the region. We need information on how intermodal competition can be exploited to encourage service improvements and operating efficiency. (For example, what are the range of modal splits that could possibly be achieved between different parts of the region given the entire range of transportation program packages that have been proposed?) To this end, the usefulness of our models for design lies in their "policy sensitivity", that is, the ease with which design judgments may be made without extensive computer simulation, but by direct observation and interpretation of the structure of the model.

5. The process of designing alternative transportation improvements is based in part upon the understanding of transportation system deficiencies and travel service inequities gained in steps such as those above. These deficiencies and inequities, already measured and articulated as specific criteria by study participants are useful for developing design principles for transportation improvements. For example, four transportation functions could be clearly identified in the Boston region. These are:

   (a) To CBD (or radial) movements, 2/

2/ CBD (central business district) is defined as the area roughinside the presently proposed Inner Belt (I-695).

(b) Through CBD (or combinations of two radial) movements,

(c) Intra CBD movements,

(d) Crosstown movements.

Transportation improvements can be defined clearly in terms of these functions. For example, alternative program packages have been defined to serve (encourage) (a) above, using one mode at the same time as they discourage (b) by another mode. Or one modal combination could be designed to serve (a) and other modal combinations used for (c) and (d). The design of such functional improvements can and should be closely related to satisfying specific evaluation criteria.

The use of this design principle requires an intimate understanding of the interrelation of land use development, travel behavior and the functional characteristics of transportation facilities. It must also be related closely to a knowledge of ongoing land-use development trends, including shifts in population, employment, and other key activities. Under the assumption that a particular spatial distribution of activity densities should be consistently promoted, there could be relatively unambiguous definitions of function for each transportation improvement alternative. In this case, proposed facilities should have forms which suit their function. For example, facilities should be tested on the basis that the projected traffic on them be primarily that which they are designed to serve (e.g. radial and not crosstown).

The information requirements from land use and travel forecasting methodology for design purposes are, as stated above, closely related to the informational needs for the process of selection. The selection process, and its forecasting component continually generates new information on the study participants' values, preferences and priorities. The "forecasting" methodology must take account of these needs. It must be made responsive, in ways such as those above, to the needs of design as well as those of selection.

The requirements imposed by the circle of "search" (design) and selection have both been examined. The final element in designing the forecasting methodology is to build on previous experience and available methodology.

Methodology

A. Building on Previous Work in the Region

There is substantial agreement among the study participants of the importance of building on the extensive previous technical analyses carried out in the region. In so doing, the values and policy assumptions inherent in the previous work should be considered and understood in order that these may be carried forward or explicitly changed by the study participants.

The data and forecasting work to be used as basic building blocks derives from the Eastern Massachusetts Regional Planning Project (1962 to 1969), the DPW "Task A", work of particular state and city agencies, private consultants working with Boston data for clients in and outside the region, and work carried out at MIT. New technique development and major new data collection should not be a part of this study. The goal is to use the results of previous development and application work and do the work more quickly and at less cost.

The excellence of the data, technical procedures and manpower available in the region are perhaps unique in the country. Evidence to this effect is the following excerpt of a letter dated Dec. 12, 1966, from the Bureau of Public Roads to Mr. Edward J. Ribbs, Commissioner, Massachusetts Department of Public Works. In referring to the socio-economic data, and the EMPIRIC Land Use Model procedures and programs, the BPR stated:

> "These data and programs represent perhaps the richest collection of detailed socio-economic information and analysis procedures available anywhere in the country at this time. We consider this a notable achievement for the Department and the EMRPP."

The following sections describe the major elements of the forecasting methodology proposed for use in this study. The most important previous work in the region in each area is also described.

B. Conventional Travel Forecasting Models

Travel forecasting as generally practiced in the major North American transportation studies, including Boston's EMRPP and "Task A", is a several-step process. The area over which travel flows are to be forecast is first divided into

small zones. The activities producing trips between and within the zones are inventoried and distributed to the zones. Networks are coded which represent each mode of transportation facilities serving the area. The networks contain nodes, which are the intersections of streets or transit routes, and links which are the route sections between nodes. Additional nodes represent the points of access and egress of trips to and from the transportation network from zones both within and outside the study area.

The numbers of trips into and out of ("attracted" to and "generated"by) each zone are next related to the activities in that zone. Total trips into and out of each zone are forecast using these relationships. The trips are then distributed between zones on the basis of the relative numbers of trips produced and attracted by the zones, and the travel times and costs between zones. The resulting interzonal trips are "split" between modes on the basis of the transportation system (supply) characteristics, the purpose of the trip, and certain characteristics of the trip maker. Trips between zones are assigned to (or laid across) the shortest route(s) between zones, and the flows on each route section accumulated. These accumulated route section or link traffic flows constitute the initial output of the traffic forecasting process. Figure 6.1 shows a schematic diagram of the process.

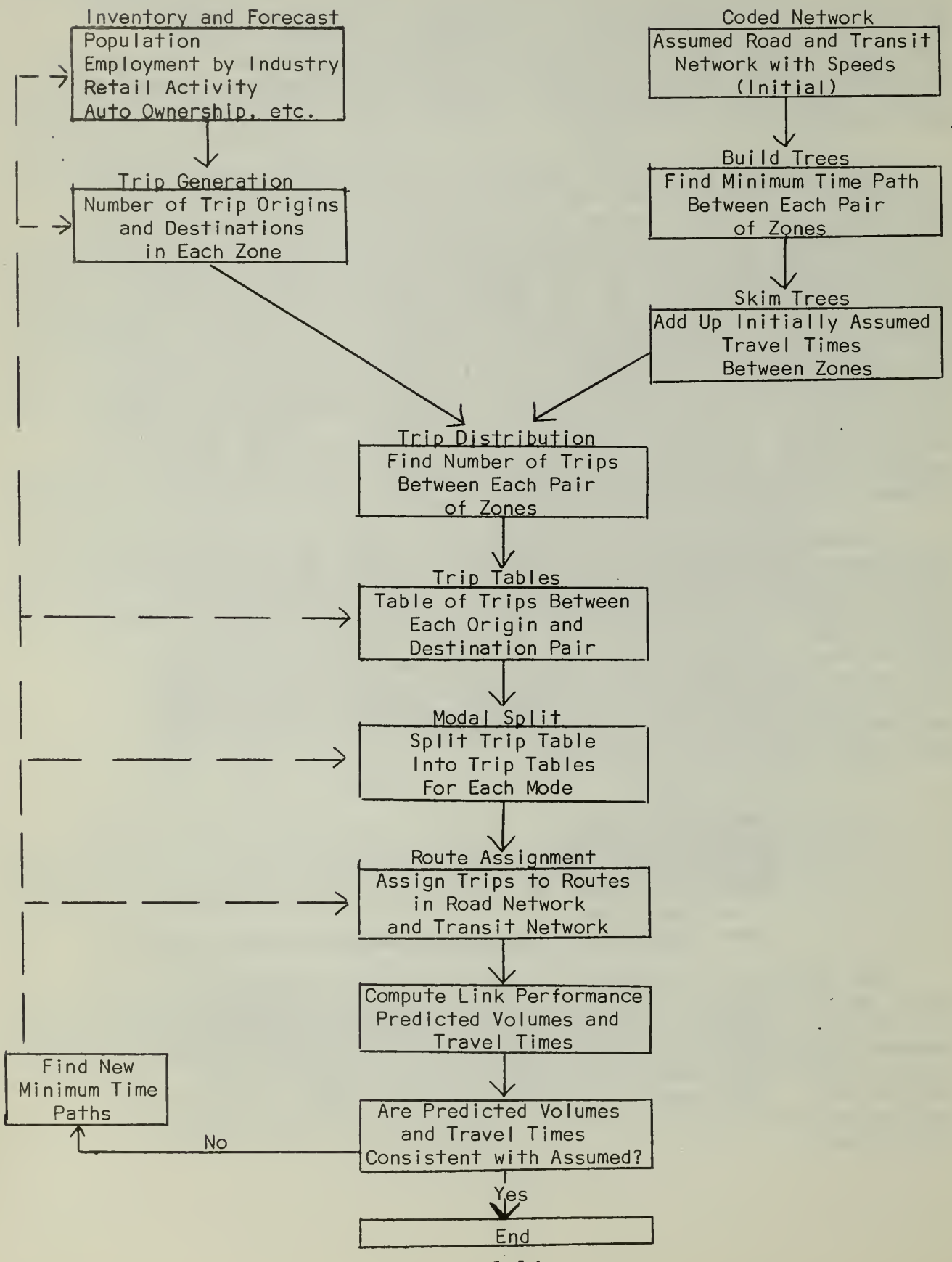
Several methods can be applied for "loading" trips between zones on to the existing and future network. A driver will normally have a number of different routes between any two zones, each having its own characteristics of distance, travel time, speed, level of service, and other design features. If the features which the driver will evaluate in choosing one route to use are well accounted for, the final volumes will be more realistic. In order to simulate his behavior several characteristics of the transportation system under test have to be known such as:

1. Link length
2. Number of lanes
3. Capacity by lane
4. Maximum speed for each link
5. Operating speed as a function of the volume on the link
6. Costs other than operating expenses (e.g.,tolls)

The analysis of demand on transportation networks is based on the theory of equilibrium of supply and demand on the network. That is, that there should be an equality between the travel conditions (times, etc.) on the loaded network, and the travel conditions used as input to the prediction. (The dashed lines on the left side of Figure 6.1 are the way this equality is introduced in the conventional procedure.)

Figure 6.1

SCHEMATIC DIAGRAM OF CONVENTIONAL TRAFFIC FORECASTING METHODOLOGY


Inventory and Forecast
Population
Employment by Industry
Retail Activity
Auto Ownership, etc.
Coded Network
Assumed Road and Transit Network with Speeds (Initial)
Build Trees
Find Minimum Time Path Between Each Pair of Zones
Trip Generation
Number of Trip Origins and Destinations in Each Zone
Skim Trees
Add Up Initially Assumed Travel Times Between Zones
Trip Distribution
Find Number of Trips Between Each Pair of Zones
Trip Tables
Table of Trips Between Each Origin and Destination Pair
Modal Split
Split Trip Table Into Trip Tables For Each Mode
Route Assignment
Assign Trips to Routes in Road Network and Transit Network
Compute Link Performance Predicted Volumes and Travel Times
Are Predicted Volumes and Travel Times Consistent with Assumed?
No
Find New Minimum Time Paths
Yes
End

The principal problems with the conventional methods are the lengthy computational procedures, and approximations involved, and the difficulty of introducing into the model sensitivity to variations in the alternative transportation policies being tested. That is, each of the blocks in Figure 1 are submodels calibrated with data on actual regional travel behavior of the type described in the block in the context of actual travel times and costs in the region. The artificial nature of the separation of travel behavior into these component travel decisions, and the computational and logical difficulty of bringing the predicted travel conditions into line with those used as input to each of these blocks (the dashed lines at the left of Figure 6.1) are the principal difficulties of the conventional procedure.

Nevertheless, the Boston Region is blessed with perhaps the most advanced and sophisticated calibrated version of this set of models anywhere. The latest version of these models (termed Generation IV models) were used in the recently completed "Task A" EMRPP Selected Plan traffic forecasts with two alternate Inner Belt (I-695) alignments. The forecasts are of A.M. peak (3 hour) 1990 travel to a highly disaggregated zone and link partitioning of the 152 city and town (EMRPP) Boston Region. Both of the forecasts can be used with the aid of expert judgment and interpretation, and the models themselves can be exercised to provide base year (i.e. existing) travel estimates on the existing network. The proposed uses of the Generation IV conventional travel model are described later under "Work Program."

C. Policy Sensitive Travel Demand Models

A singular difference between this study, and previous transportation studies in Boston and elsewhere is the wide variation in alternative transportation policies to be included in the study. The preoccupation with a single alternative with modest variations is gone. The avoidance of "no build" alternatives is gone. Proposed for testing are a wide variety of alternative relative investments in transit and highways, alternative staging policies, technologies and transfer facilities within and between modes, differences in mobility provided by transit to non-drivers, and even land use plans which it is proposed be served by given transportation systems. Perhaps this study would have been impossible until recently, if only because forecasting procedures to test such wide variations in alternative policies are a very recent development.

Historically, urban transportation planning has been narrowly focused on providing information primarily on a single criterion. This is the criterion of building to accommodate anticipated travel demand. Thus, urban transportation studies have been content to publish long-range travel demand projections on the proposed transportation system as the primary justification for the recommended plan, that is, that the facilities are big enough to accommodate the anticipated traffic. Not well understood, however, is the fact that the amount of travel is a function of the ease and speed of travel (among other factors). If a large system is laid down for testing, the traffic forecasting models tend within certain ranges to "fill it up." Not demonstrated is how well lesser systems might also accommodate the lesser amounts of traffic that would be generated. This study must use models which are sensitive to the need to answer these questions.

There has also been the problem in Boston and elsewhere of finding the changing transportation requirements of changing land use distributions. Past efforts have been generally unsuccessful. One may reflect that the transportation studies around the country took the easy way out by equating usage with demand in calibrating their models. For existing conditions, the models fit well with usage. But not generally recognized was that present usage is merely a measure of travel demand at existing levels of supply, accessibility, and benefits from opportunities at existing trip ends. Only by explaining the causal relationships underlying travel demand can forecasts be made of future changes in the performance of a transportation system with changing land uses and transportation facilities.

1. A Policy Model

The first, and perhaps principal requirement of a model for forecasting the consequences of transportation system changes is that the model be behavioral; the model should represent decisions that travelers make when confronted with real choices. In the context of this study, the model must explain the trip making behavior of individuals confronting an often large set of transportation alternatives. It is therefore essential to understand what motivates people in their transportation choices.

From demand theory, we can identify the variables relevant to demand as the price of the good or service being investigated, the prices of competing or complementary goods, and descriptors of the consumers appropriate to the commodity being forecasted. In the case

of travel, we can identify the variables relevant to travel demand as the price and service conditions of travel by the mode being tested, the price and service conditions of competing or substitutable modes, descriptors of the relevant trip destinations. The influence of the price and service conditions of the competing modes can be expected to vary according to the purpose for which the trip is being made.

For transit travel demand, the prices of the subject mode are the transit fares, travel times, comfort levels, access conditions (including station parking charges, etc.) etc. For the competing, or substitutable, auto, the prices are the parking charges, toll fees, travel times, etc. For competing transit services, the relevant prices are generally measured by the same kinds of variables as for the first or subject transit service. Theory tells us that the demand for transit travel will be negatively related to increasing costs and travel times, etc. on the subject transit mode, and positively related to the prices and travel times, etc. on the competing modes. The model parameters can also indicate over what price and service levels modes of travel are indeed competitive.

An individual's demand for final goods or services, and hence for trips, depends in large measure on his social and economic characteristics. For example, one may assume that an individual's propensity to make shopping trips depends upon his family's income and other characteristics. More shopping trips might be expected to emanate from households with high incomes, or from larger households than from smaller ones. The demand equations must therefore include variables to represent trip generation characteristics for individuals that relate to particular trip purposes.

The need for measures of output of the activities that attract trips stems from transportation's role as a derived demand commodity. That is, transportation is usually not desired for its own sake, but rather because it enables the traveler to satisfy another demand. Thus, measures of activity from which the demand for transportation is derived is needed in the transportation demand function. This requires disaggregating the trips by trip purpose and specifying the relevant measures of activity for each trip purpose -- sales, employment

etc. These measures of activity are the usual attraction variables. All else being equal, we expect the demand for transportation to be positively related to the level of operations of the activities served by transportation.

These ideas may be incorporated into the following functional form, which is a general expression for modeling urban travel demand:

$$V_{k_{ij}} = D\ (A_i, A_j, L_{k_{ij}}, L_{r \neq k_{ij}}), \qquad (1)$$

where:

$V_{k_{ij}}$ = trips by mode k between zones (or points) i and j,

$D(\ )$ = a (demand) function of ...,

A_i, A_j = activity measures at i and j,

$L_{k_{ij}}$ = price and service level conditions on mode k between i and j, and

$L_{r \neq k_{ij}}$ = price and service conditions on all other relevant modes (not same as k) between i and j.

This model states that trips by mode k between i and j are some (demand) function of the activity systems at i and j, and the price and service conditions on mode k and on all competing modes. Trips by mode are forecast directly in this model. This is direct demand estimation by mode. The potential travelers' decisions are handled simultaneously without resorting to artificial distinctions between trip generation, attraction, distribution, modal split, etc. The demand between any two zones or parts of the region can be forecast directly without having to compute all other trip interchanges in the region.

To further illustrate the proposed model concept, consider a more specific linear form of a two-mode demand model.

$$V_{k_{ij}} = a + bA_i + cA_j + dL_{k_{ij}} + eL_{r_{ij}} \qquad (2)$$

where:

The variables are defined as before, and

Within the context and timing of transportation improvements resulting from the Study, a time phased plan for conducting all relocation activities will be needed as a basis for detailed corridor or program package recommendations and for the determination of a replacement housing program.

An overall framework for such a plan will be developed to coordinate inputs from the housing related analysis outlined in this Study Element with other relevant Study activities, in particular, Business Relocation (S.E. #13), Joint Development (S.E. #5), community and private group feedback from joint design and review sessions and specific recommendations for implementation.

2. Replacement Housing Programs for Preferred Program Packages

A brief review of available housing and local housing market trends has yielded the conclusion that family dislocation caused by the alternative program packages discussed with the Steering Group and Working Committee during the course of the study design will undoubtedly be greater than can be absorbed by the local housing market. Thus it is already clear that a Replacement Housing Program involving new housing construction or rehabilitation will be required to allow construction of transportation improvements recommended in the Study to proceed.

The funding of this housing program is partially contingent upon passage of the Highway Act of 1970 (with inclusion of the replacement housing provisions) and parallel legislation at the state level to allow state and Federal highway funds to be used for the construction of replacement housing to be made available to relocatees at existing rent and mortgage levels.

This work task will be initiated as early as feasible in the Study, as soon as preliminary dislocation estimates made during the first phase are available. Criteria for determining the number, type, size, tenure, general location and price/rent ranges of new replacement housing will be determined in conjunction with A and B above. Discussions will be held with local housing agencies, and private developers to determine alternative approaches to providing needed new replacement housing (e.g. expansion of public housing programs, stimulation of specific new moderate cost housing projects, establishment of new housing agencies and programs, etc.) In conjunction with the Steering Group and Working Committee, a replacement housing program for specific new

housing developments will be recommended, including a production schedule, time-phased to provide new housing in synchronization with relocation and transportation construction schedules. This program will include identification of individual housing developments, agencies or sponsors responsible, how DOT and other funds will be used, how units will be sold or managed, and relocation preferences from each program package.

This task covers the investigation, planning, programming, and scheduling of replacement housing construction for the duration of the restudy. All work will be coordinated with DOT program guidelines being developed to administer DOT funds used for the provision of replacement housing. The need for decisive moves into problems of implementation is emphasized by the length of time needed to "tool up"replacement housing programs, even when the necessary legislation and administrative procedures exist. Thus, in Los Angeles only 11 units of replacement housing have been delivered in 2 1/2 years.3/

Work will include research into local housing agencies and programs; professional evaluation of best ways to package new housing developments; continuous interaction with residents involved with relocation from past and current proposed transportation improvements; contact with local governments; relationship to zoning; professional assistance with local and state legislative changes; legal and professional assistance in the establishment of new agencies (if necessary); formation of and recommendation of program packaging and implementation machinery.

3. Development of Preliminary Relocation Plans for Preferred Program Packages

The output of studies described above will be brought together during Phases II and III of the study under the following headings:

. . . Overall Relocation Plan

. . . Preliminary Relocation Plans for Each of the Preferred Program Packages

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3/ See DPW memorandum of November 16, 1970, p.2.

STUDY ELEMENT 11

Effects of Alternatives on Regional Economy

Alternative transportation systems can be expected to produce a variety of effects upon the Boston area economy. The purpose of this Study Element is to identify and dimension these economic impacts and to provide sound inputs into the alternative transportation system evaluation process. Of course, the broader objective is to maximize the positive economic aspects of improvements to the transportation system.

The basic tasks are to forecast economic expansion under alternative systems and devise specific implementation procedures for early achievement of potentials. The approach to the study will be to analyze the overall economy on the one hand and related transportation aspects on the other. Specific analyses will include a detailed profile of available labor resources, the desirability of existing and potential industrial sites from a transportation access standpoint, and accessibility of these sites to concentrations of worker residence.

Phasing and Integration with Other Studies

Other Study Elements will deal with the following components of economic impact:

S.E. #4, Transportation System Design--capital costs of transportation improvements.

S.E. #6, Land Use and Travel Forecasting--effects, other than above listing, on the distribution of population, employment of major type and income among communities and municipalities of the region due to changing accessibility levels of communities within the region; transportation system user costs (time, accidents and operating costs).

S.E. #5, Joint Development and the Development of Alternative Program Packages--costs of providing space for replacement of community facilities relocated, new business and housing, and the effects on tax base of communities due to alternative program packages.

S.E. #12, Replacement Housing and Family Relocation--effects on the housing market, costs of relocation and replacement housing.

S.E. #13, Business Relocation and Employment--numbers of businesses and jobs eliminated, costs of business losses and costs of relocating business due to construction of transportation;

numbers of jobs attracted to impacted communities and costs of programs to attract these jobs.

Economic Overview and Collection of Base Data

Base data on the economy will be collected and assembled in such a manner that comparisons can be made against alternative transportation systems. Data will be collected by major sectors of the economy, including manufacturing, construction, transportation, utilities, wholesale trade, retail trade, services, and government. In addition, a comprehensive overview of the regional economy will be prepared during the first three months of the study. The purpose of this overview is to provide early inputs related to economic impacts and preliminary proposals for use in evaluating possible economic elements of program packages. The economic overview will include the following:

1. Relevant characteristics of the Metropolitan Boston economy will be summarized. Emphasis will be placed on forecasts of growth and change in non-residential sectors.

2. Generalized maps showing employment concentration patterns for the Boston area will be drafted for graphic comparison with possible program package development areas.

3. Factors that may alter economic and employment opportunities will be identified and evaluated. Transportation-related factors will be carefully considered.

4. Recent experience in transportation-related (and other) economic adjustments will be evaluated.

5. Preliminary proposals for stimulating economic development through transportation improvements will be developed.

6. Preliminary evaluation will be completed using gross estimating techniques, of the comparative effects of alternative transportation systems in stimulating economic expansion.

This work task will be based on careful inventory, analysis and updating of existing materials; interviews with persons knowledgeable in economic development issues; and coordination of the findings of other elements of the study, especially those concerned with land use and travel forecasting, joint development, business relocation, and employment. The latest census and other published materials will be incorporated into the study as it becomes available. Except for reconnaissance surveys and interviews, original research will be limited to key issues for which adequate information is not otherwise available. A working paper and a series of presentation graphics will result from this portion of the study.

Analysis of Transportation-Related Economic Issues

A comparative analysis will be prepared of basic regional economic issues, Special attention will be given to the respective impacts that can be expected from the development of alternative transportation systems. The following types of issues would be included in the analysis:

Financial Assistance: The regional economy will be affected (both directly and through multiplier effects) by the amount and type of Federal and state funding which could be expected under alternative transportation packages.

Total aid funds plus multiplier effects on the economy may reach several billion dollars over the next several years. The range of aid funds among the alternatives could amount to several hundred dollars per capita.

Study Element #9, Administrative and Legislative Studies, will produce estimates of the feasibility and expected amount of Federal and state aid funds likely to be obtained to assist in financing each alternative program package and component thereof. This data will provide the simplest level of evaluation of alternatives in the form of a table showing the total aid funds by source and by component program (highways, transit, housing, etc.) and net differences among all alternatives.

The next level of evaluation, which will be performed for Phase I evaluations, will be to develop a first approximation of the multiplier effects that differences in aid funds would have on the regional economy. This would yield results in differences among alternatives in terms of dollar value to the gross regional economy and the value of goods and services of selected sectors of the economy.

In Phases II and III the results of this input-output analysis will be further refined, to give a more precise estimate of the relative impacts of aid funds, in the following ways:

(a) Estimates will be made of the effects by finer geographic breakdowns by tracing out the locational pattern within the region of the industries having the greatest differences in impact.

(b) For high impact industries, special analysis will be conducted to determine the likely implications in dollar value (estimated from the input-output table). Gains or losses of various types of jobs and the impacts on key firms in the Boston area will be investigated.

(c) Adjustments to the input-output results will be made to account for specific inadequacies in the model such as recent changes in technology of key industries.

Movement of Goods: The costs of goods movement under varying transportation systems will, in turn, affect the costs of doing business, producing goods, and providing services. The industries being served and the transportation industry are the two principal elements to be considered in this evaluation.

Major industrial types will be analyzed to determine types of products and dependence on or preference for respective modes of transportation. Basic indicators such as origin and method of receiving raw materials and the destination and shipping mode of finished products will be investigated.

As part of the Phase I evaluation of alternatives, a series of interviews will be conducted with representatives of the shipping and trucking industries and other persons knowledgeable in these industries. Respondents will be asked to comment on the likely consequences of transportation system alternatives in terms of labor costs, costs of vehicle operation, modernization, and use of containers.

As part of Phase II and III, evaluations and analyses will be made to quantify the shipping costs differences among alternative transportation systems. Data sources will include the 1963 and 1968 Census of Transportation on goods movement between Boston and other major production areas, and the 1963 EMRPP external truck trip table and forecasts based on it. Results of the traffic assignments for the alternatives to be studied in Phase II will be used to estimate differences among alternatives in average costs of goods movement between the Boston area and other cities.

With assistance of experts on the trucking and shipping industries, evaluations of differences in costs among alternatives will be translated into evaluations of likely impacts on common carrier rates.

Movement of People: Alternative transportation systems will have varying impacts on the economy through respective capacities for movement of people within the region. Accessibility of employment concentrations to areas of worker residence is a critical factor in retaining and expanding economic and employment resources. This Study Element will analyze the advantages and disadvantages of alternative transportation systems and their respective impacts on worker accessibility to existing and potential centers of employment. In addition, this analysis will investigate possible major geographic shifts of housing or employment centers within the region as a result either of transportation programs or other factors.

Distribution of Industry: Transportation systems are major factors influencing the geographic distribution of industry and other employment concentrations within the region. This has been demonstrated amply by the clustering and redistribution patterns generated by the completion of facilities such as Route 128. This Study Element will include analyses of the local forces involved in the attraction of transportation facilities for various types of businesses and industry and what the net effect of these forces would be on the regional economy. This analysis will take into account past trends, stated preferences of industry for specific types of sites, and broad-brush cost-benefit analyses of alternative transportation systems.

Economic Disruptions: The extent to which program package proposals will disrupt economic and employment resources and potentials will be documented. Key indicators to be measured against alternative program packages include the numbers of employers and employees to be displaced, by type and amount of space, and the extent to which highly productive economic and employment groupings are severed. This analysis will make use of data to be collected and analyzed in Study Element 13, Business Relocation and Employment.

Economic Opportunities: The extent to which new markets and economic expansion opportunities may be generated by alternative transportation program packages will also be investigated. Specific transportation-related issues which might stimulate economic activities and which would be included in the analysis include freer movement of the work force, freer movement of materials, and accessibility for development of additional land. In addition, direct opportunities for economic and employment expansion through construction of air rights or joint development projects and indirect opportunities resulting from increased competitiveness of selected sites and facilities would be documented.

Costs of Congestion: Expected levels of congestion associated with the alternative program packages may affect the ability of the region to compete with other regions in attracting new firms or allowing the expansion of existing firms. Specific congestion costs to be investigated for alternative program packages would include:

(1) effects on costs of doing business, producing goods and providing services,

(2) effects on attracting firms and expansion of existing firms,

(3) effects on tourism, and

(4) effects on the size of the economic hinterland and hence on distributive industries and interregional trade.

The above several analyses will be based mainly on the economic base data prepared under "Economic Overview and Collection of Base Data," as described above. Each of the issues will be measured against alternative program packages. Original surveys and data collection will be undertaken only to fill critical gaps and deficiencies which may be found to exist.

Since some of the issues identified above are extremely difficult to document analytically, a principal approach will be that of seeking informed judgments of knowledgeable people in the region, supported by reconnaissance surveys and other analyses, as required.

Through agencies such as the Greater Boston Chamber of Commerce, the Boston Economic Development and Industrial Commission, and local planning agencies, persons knowledgeable in each of the major economic sectors will be contacted and asked to comment on the probable economic magnitude of the respective issues. Taking these judgments into account, estimates will be made of the differences among alternatives in those factors (primarily transportation costs of various types) which are likely to have significant impacts on selected major industrial groups.

The results of this section will be documented in a working paper and other presentation materials as required.

Ecomonic Development Program

In addition to providing key inputs into the overall evaluation of program package alternatives, all the studies, surveys and analyses described above will be integrated into a summary program statement setting forth feasible economic development opportunities which could be achieved as an integral part of the transportation program. The program would be based on the respective needs for transportation improvements in various parts of the region to stimulate economic and employment expansion. Important elements of the program would include the following:

1. Delineation and description of important economic centers within the region.

2. Assignment of priorities for enrichment of these areas through transportation-related activities.

3. Preparation of a staged action program for improvement of the economy through the transportation improvement effort.

4. Preparation of a program for participation of community organizations and other interest groups in the economic development program.

5. Identification of economic development incentives that might be provided as a part of the transportation program.

STUDY ELEMENT 12

Replacement Housing & Family Relocation

The Federal Government provides financial assistance for relocation services in instances where families are displaced by public improvements funded in part by Federal funds. In addition, new legislation presently before Congress would allow the construction of replacement housing with Federal funds. Presently, the type, nature and extent of the assistance varies somewhat with the type of public improvement causing the dislocation. All Federal funds provided for relocation services, however, are administered by the local agencies responsible for providing relocation services.

Relocation experience to date in metropolitan Boston points out several areas of concern in planning family relocation services for future transportation improvements. First, the existing administrative structure of numerous local and state agencies providing relocation services within the same metropolitan area has been criticized by participants in the study design process as fragmentary and unequal in services provided. Larger agencies such as BRA are able to provide more comprehensive assistance than smaller agencies in other jurisdictions. Survey methods vary among agencies making data interchange difficult. Relocation procedures also vary in sophistication and with the size of the workload, such that a family displaced by a rural highway project might receive far different treatment than a family displaced by a mass transit improvement in Boston.

Resources are often double or triple-counted by different jurisdictions or different relocation plans in the same jurisdiction. Administrative costs are proportionally higher with numerous administrative units providing services. Policies regarding the maximum acceptable geographic distance between original house and relocation house vary. Ability to expedite services in large scale projects varies, as does the ability of the agency to provide social services and security for families in large-scale relocation efforts.

It has been noted during meetings with state and city relocation agencies that future family relocation problems in metropolitan Boston will be compounded by the tightening situation in the regional housing market and the recent decline in subsidized housing activity. In recent years, family relocation was less difficult than it will be in the early 1970's due to more rapid

turnover in housing, resources generated by the public housing leasing program (approximately 2,800 units),1/ and generally higher vacancy rates in many sections of the metropolitan area. The recent decline in new construction, rehabilitation and housing transfers due to completion of several local programs and the national economic situation will result in diminishing relocation resources in all price and household income ranges.

This situation on the supply side is a source of considerable concern on the part of local relocation experts, and a major potential problem is planning future transportation improvements.

Need for an Overall Relocation Plan

A major problem with existing relocation efforts is that all such efforts are determined and planned separately, with overall coordination existing only at the State Bureau of Relocation Assistance. An overall guide for all relocation services planned for transportation-related improvements is necessary, even if such a plan is general in nature and subject to modification as each specific program package is developed.

Replacement Housing

It has become clear during the restudy design process that the construction of any major transportation facility requiring the taking of residential property will have serious negative impacts on the already tight housing market.2/ This will be especially true for low income groups and the low rent sector of the market. Thus, it is recognized in the definition of work to be undertaken in this Study Element that the projection, location, density and implementation of a substantial replacement housing program will be of central importance.

It is also recognized that present Federal transportation programs do not provide for the planning (except in exceptional cases) or the construction of replacement housing with Federal funds.

1/ These public housing resources should be compared with the magnitude of displacement associated with the construction of large scale transportation facilities. For instance, the D.P.W. Plan of 1962 for the South West Expressway alone indicated 2,106 households displaced; p.V-21, Table B.V.

2/ This is the position of the Municipal Caucus and is corroborated by staff discussions with relocation agencies; see Memo to the Working Committee, October 13, 1970 "Transportation Restudy--Review of Sections II and V."

However, it is anticipated that new legislation will be enacted by Congress in the 1970 Federal Highway Act which will make such funds available. It is also anticipated that similar changes will be achieved in state legislation during the period of the Study.

Phasing

The following sub-tasks have been identified:

A. Preliminary Determination of Relocation Workloads for Alternative Program Packages

B. Preliminary Determination of Replacement Housing Resources and Needs for Alternative Program Packages

C. Development of Preliminary Relocation Plans and Replacement Housing Programs for Preferred Program Packages

D. Analysis of the Legal and Administrative Structure of the Relocation Process

The earlier phases of the study process will be concerned primarily with the preliminary analysis of Phase I alternatives, the collection and refinement of base data, and the development of standards for the listed criteria. It should be noted that the D.P.W. has already made surveys of displacements associated with large parts of the proposed EMRPP Highway network, notably for Interstate Routes 95 and 695, for different routes in the city of Cambridge and for Route 2. This data together with experience gained in the actual relocation of families and businesses from highway projects already underway or completed, will form a useful base to be supplemented by both up-dated material and new information related to new alternatives developed within the Study process. As the number of alternative program packages is reduced through Phases II and III, the overall relocation plan will be developed and the preliminary relocation plans and replacement housing programs for preferred program packages defined. Thus, of the above sub-tasks, D will be carried out primarily during Phase I, sub-tasks A and B during Phase I and II and the more detailed planning work of C will occur during Phases II and III.

Private Group Participation

Recognizing the very high degree of legitimate concern among local community groups, particularly those in existing and proposed transportation corridors, with relocation problems, the maximum feasible interaction with such groups is implicit in all of the study tasks described below.

A. Preliminary Determination of Relocation Workloads for Alternative Program Packages

The amount and type of displacement caused by alternative transportation program packages will be a key determinant of the acceptability of each package. The displacement implications for each defined program package will be assessed at various phases of the Study process.

The first estimation will be during the initial four months and will be based purely on available data without detailed field surveys. Existing demographic information, 1970 census data (to the extent available) and past surveys conducted by relevant agencies, will be used to estimate the number of families by:

(1) size

(2) race

(3) household income

(4) length and type of tenure

(5) social service requirement, and

(6) anticipated relocation costs.

In addition, issue reports will be prepared on special difficulties associated with relocation or the provision of replacement facilities.

A procedure for continuously estimating disruption and relocation implications of alternative program packages as they are defined will be established for use as the mix of transportation and other facilities is adjusted during the course of the restudy. As options are narrowed during the restudy and a preferred set of program packages emerges, relocation workloads for these packages will be more closely estimated. This second estimation will involve sample surveys in the specific transportation corridors being selected using the procedures developed below. The extent of the sample and sampling technique will be determined on the basis of budget available for this second estimation. Output will include a report on the anticipated family relocation workload associated with each program package, family characteristics, anticipated relocation costs, an estimate of time required to accomplish relocation, and desirable social service packages to be provided.

The methodology to be used will be appropriate to the level of analysis and evaluation applied to succeeding phases of the Study and will include:

. . . Analysis of 1970 census data;

. . . collection and analysis of other demographic data and forecasts;

. . . interviews with local population experts and key agency staff;

. . . study of various sample survey techniques;

. . . conduct of sample surveys with locally employed surveyors;

. . . automatic data processing of sample survey results;

. . . continuous discussions with Steering Group and Working Committee.

B. Preliminary Determination of Replacement Housing Resources and Needs for Alternative Program Packages

The work tasks outlined in A above deal with the potential demand for relocation and replacement housing associated with alternative program packages. The purpose of the work outlined here, to be accomplished simultaneously with A, is to determine what replacement resources are available, and to dimension programs for the construction of new replacement housing.

Housing resources will be analyzed twice during the Study. The first analysis will occur during the initial four month preliminary planning phase, the second will be associated with the Phase II and III when a consensus on acceptable program packages is emerging.

The first inventory will be based on information available from local housing agencies, renewal agencies, existing market studies, 1970 census data, interviews with local housing experts and local large volume developers, and other available secondary source data. Criteria for acceptability and adequacy of housing will be determined for each program package under consideration. These criteria will be used to evaluate replacement housing resources, and preliminary determinations as to the availability and adequacy of replacement housing for each program package will be made. This effort during the first four months of the Study will yield an estimate of the amount, type, size and general location of replacement housing, in excess of existing resources, that will be required to be provided with DOT assistance under the expected provisions of the 1970 Highway Act. This estimate of additional replacement housing requirements triggered by each alternative program package, and the associated costs, will be a key input to the selection of preferred program packages, and leads

logically into the definition of specific programs and implementation activities in C and D below. Throughout the Study, a continuous inventory of available and soon-to-be-available replacement housing for relocation efforts will be kept in accordance with acceptability criteria determined during Phase I. This will allow staff professionals and participating citizens to estimate the amount of DOT-assisted new housing construction that each alternate program package would require.

As a consensus emerges on a preferred set of program packages a second, thorough inventory of replacement housing resources will be made. Replacement resources will again be evaluated for acceptability, and a final determination of the amount, type, size, general location, and estimated cost of required DOT-assisted replacement housing will be made. This determination will be based on the relocation workloads for each preferred program package as determined in A above, and will (1) identify the available and soon-to-be available housing to be used to satisfy relocation requirements, and (2) the volume of new or rehabilitated replacement housing that is necessary to allow actual construction of transportation facilities in each program package to proceed.

Specific tasks associated with this effort will include:

. . . an inventory of available data on vacancies, turnover rates, new housing under construction, housing soon-to-be constructed, and anticipated future construction and rehabilitation by type, size, tenure and location;

. . . interviews and continuous liaison with local housing, renewal, relocation and other relevant agencies and individuals active in the local housing market;

. . . interview and continuous liaison with key builders, developers and real estate brokers in the Boston metropolitan area;

. . . display of replacement housing resources on maps and charts including dates of availability for planned new housing;

. . . continuous testing and updating of replacement housing inventories with individuals contacted.

C. Development of Preliminary Relocation Plans and Replacement Housing Programs for Preferred Program Packages

1. Overall Relocation Plan

value scale to aid in comparisons of alternatives and to attempt to provide commensurability among the various types of environmental and conservation criteria.

The impact of noise on adjacent land use activities will be measured by the application of standard, published relationships and techniques. Estimates will be made of the projected decibel levels associated with each alternative program package in relation to the type of operation, volume of traffic and varying distances. These noise measures will be compared with the field measurements of ambient noise and translated into statements of the degree to which they disrupt normal human activity of various kinds adjacent to the transportation facility.

Using existing data, estimates will be made of the ambient levels of air pollution that can be expected, by type of pollutant, in the vicinity of highways and streets which form part of, or are affected by program package proposals. These impacts will be analyzed in relation to existing levels of pollution as determined by the field surveys and expressed as a function of the volume and type of operation of traffic. These estimated pollution levels will be related to critical standards that have been set by relevant authorities.

Air pollution levels will be estimated by major type of pollutant for the Boston region as a whole, in addition to the more localized neighborhood estimations described above. Regional estimates for each alternative system will be functions of total amount of movement as well as levels of congestion.

In addition to these tasks, this Study Element encompasses the evaluation of the environmental and open space components of alternative program packages against the relevant listed criteria in Section IV, e.g.:

1. Economy

   A. (1) Property Costs
      (4) Replacement Facilities
      (14) Relocation Programs

4. Community Qualtiy

   A. Noise Levels
   B. Air Pollution
   C. Visual Psychological Barrier
   D. Neighborhood Disruption
   E. Social and Cultural Impacts
   H. Visual Characteristics (1-6)
   I. Effects on Natural Features (1-6)

5. Acceptability and Adaptability

B. Adaptability to Social/Environmental Programs

6. Distributional Effects

B. Land Use Distributional Effects

4. Recommendations for Design Specifications and Implementation

Throughout the phases of the study, those decisions upon which consensus can be reached will be pressed forward toward implementation. It will be necessary to develop specifications and to recommend methods of administering the implementation process so that critical environmental values identified during the study process will be observed. For instance, it may be desirable to specify a certain construction procedure or timing in order not to disturb unique or valuable wildlife habitats, or ecosystems.

Recommendations, although unique to the particular area of interest of this Study Element, will form input into the implementation recommendations attached to each program package and the final report of the Administrative and Legislative Studies (S.E. #9).

. . . Estimations of relocation costs, social service requirements, time phasing, etc.

. . . Specific evaluation of each preferred program package against the relevant criteria listed in Section IV.

. . . Definition of procedures and performance standards for the implementation and construction process.

(1) Overall Relocation Plan

The Overall Relocation Plan will coordinate on a metropolitan wide basis the relocation and replacement proposals associated with all recommended transportation improvements, including outputs from the Business Relocation Study Element (#13). The plan will indicate the extent to which families dislocated from a certain area can be rehoused in the same area, the total effect of new housing programs on different parts of the region, etc. The plan will, therefore, be a policy document with family settlement and neighborhood change implications extending beyond separate corridors.

(2) Preliminary Relocation Plans for Preferred Program Packages

Inputs to these detailed plans for the Phase II and III evaluation will be developed from preliminary analysis of relocation workloads for each program package from A above; preliminary analysis of replacement housing resources from B above; recommendations on administrative changes from emerging program package detailed, preliminary designs, priorities and timing from other Study Elements.

As relocation workloads are estimated for various alternative program packages, those estimates will be matched with resources available in the same geographic area. Conclusions will be continuously drawn during the restudy process as to the availability and adequacy of available resources in close proximity to generated family dislocation. These analyses will be a continuous input to policy and priority decisions regarding each program package.

(3) Estimates of Relocation Costs, Social Service Requirements and Time Phasing

Estimates will be prepared of all of the costs associated with the detailed, preferred program packages described in(2) above. Costs will be estimated for acquisition,

construction, moving expenses, compensation, temporary facilities, additional social and municipal services and so forth. These estimates will serve as inputs to (1) and (2) above and, in particular, to (4) below.

(4) Specific Evaluation of Each Preferred Program Package Against the Relevant Criteria

As a consensus on specific program packages emerges, the process of evaluation will become increasingly more detailed. Each program package developed will be evaluated against all criteria. In Phase I, this evaluation will be at a level of specificity appropriate to the description and number of alternatives to be evaluated. In succeeding phases, the level of detail will increase and it is expected that additional criteria will be developed and added to the preliminary list outlined in Section IV, e.g.:

1. Economy

   A. (1) Property Costs
      (4) Replacement Facilities
      (5) Moving Expenses
      (10) Compensation during Construction
      (12) Changes in Rent Levels
      (13) Continuing Services
      (14) Relocation Programs

4. Community Quality

   E. Social and Cultural Impacts

6. Distributional Effects

   A. Effect on Selected Groups (1-6)

(5) Definition of Procedures and Performance Standards for the Implementation and Construction Process

The analysis of the legal and administrative structure of the relocation process is the subject of a subtask description immediately following. A major input into that subtask will be recommendation from private groups, the Steering Group and Working Committee on criteria and performance standards to be applied to the implementation of each defined program package.

D. Analysis of the Legal and Administrative Structure of the Relocation Process (see also S.E. #9)

A preliminary task will be to thoroughly analyze the interagency relocation process within its legal and statutory framework with a view toward recommending organizational and procedural changes to improve the process.

Existing Federal, state and local laws will be examined to determine legislative intent and constraining requirements that have shaped the existing administrative structure and relocation process. Hypotheses of alternative administrative organizations such as a single regional relocation agency will be tested, along with determination of legal changes necessary to institute such changes. Recommendations will be made as to preferred alternative reorganization or procedural changes necessary to conduct future transportation related family relocation. Outputs will include a written report stating these recommendations as well as criteria to evaluate the adequacy of interagency organizational arrangements and relocation processes.

A working draft of this report will be developed during Phase I of the Study to serve as an aid in the evaluation of alternative program packages. It is expected that the draft will be modified and refined as the number of alternatives is reduced, criteria are developed, and decisions are made.

STUDY ELEMENT 13

Business Relocation and Employment

Displacement of businesses, especially small and medium sized businesses, is a critical issue in the planning and development of a balanced transportation system in the Boston area. The findings of the Governor's Task Force and analysis of recent relocation experience demonstrate that the impacts of business displacement range far beyond the immediate problems of finding space for businesses to be relocated at prices which they can afford. Related, and equally important concerns which must be resolved include the disruptive effects of displacements on neighborhoods, disruptive effects on the economy, and the need for workable implementation procedures including adequate financial payments and possibly new or revised legislation to assure proper treatment of displacees. The proposed study is designed to treat both the immediate problems and the critical related problems.

First, the direct problems include relocation workloads, costs and available resources. In order to dimension the relocation problem and to provide a basis for development of realistic implementation programs, it is necessary to determine in detail the displacements which would result from proposed program packages and identify resources which would be available to fill these requirements. This involves careful analysis of proposed program packages and determination of relocation work loads and costs associated with each.

In addition to basic workload and resources information, a number of additional factors related to business displacement would receive attention in the study. Some of the more important related concerns would be as follows:

Neighborhood Disruptions

Since neighborhoods are often dependent upon certain small businesses for goods,services, and employment, business displacements are potentially disruptive to neighborhoods. The study would evaluate this type of disruption as a critical factor in the transportation system. A key element would be a strong and workable participatory process, whereby neighborhood interests could express concerns about the impacts of various transportation-related activities and be involved in the development of relocation programs and procedures. It should be noted that business relocation experience to date has been limited primarily to downtown type situations and the critical issue of neighborhood impact of business displacement has not been analyzed or resolved.

Economic and Employment Disruptions

Business displacements are potentially disruptive to the economy, especially in terms of employment adjustments. A major objective of the study would be to specify ways not only to accommodate business dislocations, but to actually expand employment in the process. To achieve this, it is anticipated that there will be a need to maximize the amount of space and facilities available for small and medium sized business establishments, especially in the denser portions of the metropolitan area where the labor force is concentrated. This need might be reflected in innovative development techniques related to the highway program. These proposals include air rights and joint development projects to minimize any usurping of potentially productive space for transportation purposes; the innovative use of funding and relocation payment techniques (especially SBA assistance); the possibility of providing unified or grouped space and facilities for displaced businesses (perhaps similar to experiments already under way in the Boston area); and providing special subsidies to assist in needy and difficult relocation problems. Proposed program packages which disrupt existing industrial corridors would be identified and given special consideration.

Implementation and Feasibility

Implementation and financing procedures would form a vital element in the study in the face of the knowledge that small businesses typically have a high mortality rate in relocation processes.

The major thrust of the implementation effort would be to devise feasible programs for providing replacement facilities and developing employment opportunities. Several critical concerns will be covered:

. . . an evaluation and recommendation related to current legislative, administrative and financing procedures under which relocation is handled;

. . . proposals for providing adequate lead time for replacement facilities and for dealing with displacees;

. . . development of innovative ways to provide financing; and

. . . designing mechanisms for co-ordination of assistance programs.

Another major concern might be to propose jurisdictional changes to eliminate overlaps and disorganization.

Phasing and Integration with other Study Elements

Although the objectives of the work under this Study Element are very specific, inputs will be coordinated from a wide range of other study activities. Thus, in defining the overall characteristics of employment in the Metropolitan Region data from Study Element #11, "Effects of Alternatives on the Regional Economy," from Study Element #6, "Land Use and Travel Forecasting," and Study Element #5, "Joint Development," will be used.

Similarly, the outputs from the study, as well as having specific action recommendations, will have significant effects on the acceptability of program packages. A particularly close coordination will exist with Study Element #7, "Special Mobility Studies," and the development of recommendations involving employment programs combined with appropriate special transportation services will be an objective.

In Phase I, the coordination of base data and the identification of opportunities will be the most important tasks. Through Phases II and III the development of more specific recommendations and their incorporation into program packages will be achieved as the numbers of alternatives are reduced.

Work Tasks

A. Development of Base Data and Preliminary Analysis of Phase I Alternatives

A background analysis covering basic information on small business relocation and employment activities will be prepared during the early weeks of the study. The purpose of this overview is to provide a basis for forecasting and evaluating the impacts of future business relocation activities. The subtasks will include the following:

1. A general description of transportation program packages and their respective impacts on business displacements will be prepared. This analysis shall be in sufficient detail to indicate the level of business disruption associated with each of the proposed program packages. Special cognizance shall be taken of indicators such as commuting patterns and ethnic concentrations. Planning and zoning regulations critical to concerns of this study shall be identified and evaluated.

2 The legal and administrative bases for conducting business relocation activities shall be evaluated. Special emphasis shall be placed on identifying

which agencies are currently responsible for providing relocation services in the metropolitan area, the scope of their responsibilities, the geographic limits of their operations, the legal basis for their activities, and the extent to which nonresidential activities are specifically covered.

3. Data shall be collected on current and projected public and private investment plans, in particular those associated with industrial expansion, or relocation.

4. An economic and employment overview of the metropolitan Boston area, together with preliminary evaluations of the comparative effects of alternative transportation systems, will be prepared under work tasks described in Study Element #11. This data will be analyzed in order to examine the role of small and medium sized businesses in the local economy, and the influence of transportation factors on their future development.

Methodology for the above work tasks will include careful inventory and analysis of existing materials; interviews with relocation and employment related agencies and groups; workshops with community groups concerned with job opportunities; special reconnaissance surveys; and coordination of materials and data derived from related Study Elements. A working paper and a series of graphics will result from the study.

B. Preliminary Determination of Business Displacements

An analysis of business displacements which are likely to result from the alternative program packages will be completed. In Phase I this analysis will be at an appropriate level of detail consistent with the need to evaluate a large number of alternatives. As the number of alternatives are narrowed through Phases II and III, a more detailed analysis involving field surveys of individual corridors will be undertaken. The purpose of this analysis is to make possible a comparative evaluation of the various program packages in terms of their potential displacement of small businesses. The major elements of the study will be as follows:

1. Based on surveys of selected areas, a tabulation of businesses to be displaced will be prepared to include at least the following data:

    (a) Name, type and location of business
    (b) Employment data (number, skill level, etc.)

(c) Approximate date of taking
(d) Size, type of construction, age and condition of structure
(e) Special facilities required
(f) Approximate cost of relocation (payments, moving costs)
(g) Eligibility for assistance programs

2. A summary statement and tabulation of business relocation workloads per program package shall be derived from the activities described in item 1 above. The tabulation shall include information on square footage by type of business (space use analysis), employment data, and total number of establishments to be displaced by time period, and other relevant data.

Based on the results of A and B above, an analysis of the impacts of alternative program packages on small business and related employment will be prepared.

The following impacts of the preferred alternatives will be measured against the criteria listed in Section IV of Part One. Specifically, indicators will be developed for the following:

1. Economy

(1) Property Costs
(5) Moving Expenses
(9) Change in Tax Base
(10) Compensation during Construction
(14) Relocation Programs

4. Community Quality

E. Social and Cultural Impacts

In order to measure the implications of relocation projections, an estimate will be made of the supply of relocation resources available.

1. Business relocation resources will be identified and recorded. Relocation resources tabulations will indicate whether suitable relocation facilities are available within the displacee's immediate neighborhood trade area or elsewhere in the metropolitan area.

2. Based on a comparative analysis of projected workloads and available resources, a tabulation of business relocation gaps and deficiencies will be prepared and specific remedial proposals will be developed.

Remedial efforts to be considered will include air rights and joint development projects, urban renewal, formation of profit or non-profit corporations to provide commercial space for relocation, and other appropriate techniques. Opportunities for joint development projects will be coordinated with design work in Study Element #5.

Two critical levels of impact will be considered:

...Impacts on individual businesses;

...Impacts on the immediately surrounding neighborhoods.

The purpose of these analyses is to allow systematic evaluation of the relationships of proposed program packages' business displacement. The major work elements will correspond to the two levels of impact and will include the following:

1. The analysis of impacts in individual businesses will include development of criteria for measuring the relocation impact on potential displacees and an analysis of the individual establishments affected. The latter will include the level of dependence of a business on a specific location; an evaluation of special characteristics of existing space and facilities; and locational determinants related to characteristics of owners, operators, employees, or clientele (e.g., health, ethnic background, mobility, etc.).

2. The analysis of impacts on surrounding neighborhoods will include development of criteria for measuring such impact and, subsequently, determination of the extent to which the neighborhood is dependent upon the establishment for necessary goods and services. Emphasis will be placed on trade area and business volume analyses and the availability of suitable relocation facilities within the neighborhood.

The methodology for the above work will include comparative analyses drawn from other sections of the study; original surveys as required; negotiation and coordination with operating relocation agencies and interests; and negotiation with officials of existing assistance programs such as the Small Business Administration.

C. Definition of Local Employment Impacts Associated with Alternatives

Metropolitan Employment Profile

Based on data gathered in Study Element #11, a profile of current metropolitan area employment will be prepared. The purpose of this analysis is to provide an accurate employment basis against which program package alternatives can be measured and refined. Specific work tasks shall be as follows:

1. The size, characteristics, skill levels, places of residence and other representative indicators of the local work forces of impacted communities will be described in detail.

2. Geographic locations of employment concentrations will be plotted and analyzed. Special attention will be paid to employment concentrations which relate to proposed transportation projects or which have been identified in Study Element #7.

3. The stability of various employment sectors (including potential for expansion or reduction of work force) and their likelihood of remaining in current locations will be evaluated.

4. Recent or projected adjustments in metropolitan employment patterns will be reviewed and adjusted as necessary based on most recent data available. This analysis will include evaluation of spatial, functional, skill level, and other pertinent characteristics.

Impact Area Analysis

Based on the findings of S.E. #11 work, employment "impact areas" will be selected and carefully analyzed. The purpose of this analysis is to dimension the impacts of program package alternatives on localized employment concentrations. Work tasks will include the following:

1. The extent to which program package proposals will disrupt current employment resources and opportunities will be determined in detail. Key indicators to be included are the number of employers to be displaced, amount and type of space to be displaced, and the extent to which employment concentrations are severed. This analysis will be coordinated carefully with Study Elements #5, 7, and 12.

3. The extent to which program package proposals will enhance employment opportunities will be determined. Transportation improvements may provide direct employment opportunities through construction of air rights or joint development projects and indirect opportunities by increasing the competitiveness of selected sites and facilities.

4. Based on the above determinations, program package alternatives will be valued according to their disruptive impacts on local employment.

Work will include comparative analyses of program package proposals; and original surveys as required.

D. Business Relocation and Transportation Related Employment Program

The above analyses will be integrated into a comprehensive time-phased program to accommodate anticipated business displacement and employment adjustments resulting from the construction of transportation facilities. The program will be keyed to the relocation workload and resources cited above and will be sensitive to the businesses being displaced, their clientele, and the economy of the larger community. The program will be closely coordinated with the Replacement Housing and Family Relocation program (S.E. #12) and will be developed within the framework of the Overall Relocation Plan described in that Study Element. Work elements will be tailored to the workload, impacts, and resources analyses described above and will cover at least the following:

1. The legal and administrative needs and resources related to business relocation will be reviewed and evaluated. Necessary changes, if any, in laws, ordinances, administrative and staffing procedures, etc., will be outlined and proposed in coordination with Study Element #9.

2. Techniques for improving relocation resources and procedures will be developed. Emphasis will be placed on new uses of existing sources such as Small Business Administration loans and services, highway relocation funds, and other available subsidies and new mechanisms which may be identified.

3. Relocation needs, resources, and proposed programs will be matched into the overall relocation plan and integrated with the preferred program package.

4. Opportunities for employment expansion through projects directly related to program package proposals will be identified.

Implementation program proposals will concentrate on methods for providing replacement facilities and expanding employment opportunities through development of new methodologies and financing techniques. Specific elements of the study would include:

1. Analysis of legislation and proposed changes, if needed, to increase and streamline relocation financing and services;

2. Design of coordinating mechanisms and identification of roles for various existing agencies such as the Boston Economic Development and Industrial Commission;

3. Design of coordinated promotion programs aimed at increasing employment opportunities in critical locations;

4. Development of methods for combining or expanding relocation payments from existing agencies such as urban renewal, highway programs and Small Business Administration;

5. Coordination of joint development, air rights, urban renewal, or other transportation-related projects to insure that they serve the interests of employment opportunity and expansion and business replacement resources;

6. Identification of "opportunity sites" upon which new or expanded employment opportunities may be provided in conjunction with program package proposals. Preliminary site plans may be prepared for selected sites as part of the Joint Development design tasks;

7. Preparation of preliminary marketability studies for potential industrial sites. These studies will be in sufficient detail to assist local agencies in promoting and developing the land or facilities;

8. Development of Techniques for expanding employment opportunities related to transportation.

a = a constant,

b = a set of constants, one per activity measure at i,

c = a set of constants, one per activity measure at j,

d = a set of constants, one per price or service condition, on mode k, and

e = a set of constants, one per price or service condition, on mode r

In this simple but complete model, for purposes of explaining the model structure, assume mode k is transit and r is auto. A separate equation is structured for each mode and trip purpose.

An important feature of the model is the way the price and service conditions of the competing modes are included in the estimation of demand for the subject mode; the d coefficients in equation (2) express the way transit usage varies with the cost and performance of the transit system in this two-mode model; the e coefficients express the demand cross-relation with the competing or substitutable service, namely auto. In the language of the economist, the e's provide the basis for measuring the cross-elasticities between transit and auto.

The cross-elasticity is therefore structural, behavioral and oriented toward decision making. It is structural because it postulates a causal relationship between a set of variables to be predicted from the model, traffic flows, and another group of variables given outside the model, socio-economic variables and system characteristics. It is behavioral because the theory that expresses the relationship is founded on an analysis of the trip-making calculus of the individual who is confronted with a trip-making decision. The model is oriented toward decision making because it explicitly included policy variables in its causal framework.

2. Model Availability

The Boston Region has the only existing calibration of the cross-elasticity model with urban area travel and socio-economic data. The calibration was carried out in 1966 for the Boston region subdivided into 97 subregions and using 1963 data. The results of this model calibration have been widely reported in the literature. 3/

3/ Domenich, Kraft and Vallette, Estimation of Urban Passenger Travel Behavior, paper presented at the Annual Meeting of the Highway Research Board, January 1968.

The 97 subregions for which this model is estimated are also the same subregions for which a version of the EMPIRIC land use model (described below) has been calibrated. Also, the model has been implemented on the only true supply-demand equilibrium traffic assignment program that exists, namely, MIT's DODOTRANS.

The primary disadvantage of the model is its relatively untested nature. It has been applied for forecasting purposes only in the San Francisco area. It must therefore by used with some caution in this study. Its primary use would appear to be in the initial testing at a high level of aggregation (97 subregions) for differences in usage and performance between widely varying alternative transportation and land use plans and between forecast years. It should only be used with caution to help establish levels of usage of particular facilities, particularly at a fine level of detail. For these reasons, namely, to reduce the uncertainty attached to absolute levels of usage and to forecast travel later in the study at a finer level of detail, conventional procedures are also proposed to be applied in the work program.

3. Land Use Models

Future activity levels form the basis for travel demand forecasting. Trips depend on the land uses and activities at either end of the trip. This information is used to forecast future travel on the entire transportation network. However, the nature of the present study demands that land use and transportation facilities be brought into consonance with each other. This means the proper feedbacks between transportation service and land development must be explicitly included in the analysis. This raises the most difficult methodological question of how much changes in the transportation system affect the levels and distribution of urban activities.

The simpler question is the one treated in the previous section. That is predicting the travel changes which an individual makes in response to changes in his transportation alternatives, given the location of his home, his place of work, and the location of shopping facilites, schools, recreational areas, and so forth. In the long run, of course, these latter factors are also open to change as transportation alternatives change. Ideally, then, we should be able to describe not only how the traveler makes travel decisions in response to changes in the characteristics of the transportation system, but also how the locations of

residences, jobs, and various facilities change in response to changes in the transportation system. A model which describes the first sort of decision is often called a short run (travel) demand model; that which describes the second is called a long run demand or demand shift (land use) model.

It is reasonably well understood that a transportation improvement which reduces travel times and costs between two points leads to an increase in travel between those two points. Since travel as noted above is a cost normally incurred as an intermediate cost in order to obtain some other satisfaction, such as taking care of personal business, shopping or obtaining income through work; an increase in travel between two points reflects increased activity at these points. These activities may be measured in terms of sales, employment or resident population, etc. However, as many observers have pointed out, neighborhoods and business areas grow and decline in response to a great number of constantly changing factors.

Changing manufacturing and business practices, school quality, topography, relative obsolescence of buildings, tax rates, neighborhood amenities, crime rates, social status, etc., are all important. Transportation is only one determinant of growth and decline, perhaps one of the better understood ones partly because of work done in Boston.

(a) The EMPIRIC Model

The Boston area is fortunate in having a recent history of substantial analysis of its changing land use patterns. The Eastern Massachusetts Regional Planning Project (EMRPP) undertook to develop in the period 1963-66 and apply in 1967-1968 a comprehensive land use forecasting technique known as EMPIRIC. Much understanding was gained with the technique on how much the various parts of the region were growing and declining in response to changing conditions, particularly changing transportation conditions. In the time frame for the present study, only a small amount of systematic analysis of land use change can be carried out that will add to our knowledge of relationships between land use changes and changes in the transportation system.

The EMPIRIC Land Use Forecasting Model is a technique, programmed for the computer, which distributes to subregions future year regional totals of urban activities such as population and employment. The model was used by EMRPP to produce land use forecasts which could be used as input to traffic forecasting techniques being applied for the Region, and to be sensitive to public policy inputs so that the model could be used as a regional planning tool to test alternative development plans; i. e., to measure the impacts on development patterns of alternative sets of public policies.

The model consists of a set of simultaneous linear equations. The (output) variables to be forecast (population, employment, etc.) are formulated as changes in subregional shares of activities. They are related to the independent variables (transportation accessibilities, etc.) by various hypothesized relationships which have been tested by a number of techniques, and finally estimated using simultaneous regression techniques on data for two points in time. After solution of the set of equations for each subregion, the changes in shares of the output variables are added to the appropriate shares of activities at the beginning of the forecast interval to obtain the new subregional shares of activities at the end of the forecast interval. Absolute subregional levels (externally forecast) of activities are obtained by multiplying these new shares by exogenously specified regional control totals for each activity. A new set of forecasts is then made for the next forecast interval. The process continues until the final target year is reached. The model, therefore, is operated recursively, and is an activities distribution or allocation model.

Two models have been calibrated for the Eastern Massachusetts Region. One model forecasts total population, manufacturing employment, and non-manufacturing employment for 97 subregions, and was designed to test four alternative regional development plans, and their corresponding sets of public policies, quickly and inexpensively. The other model forecasts four categories of population by income and five categories of employment by industry for 626 traffic zones, and was designed to test two selected development plans in a more detailed manner than with the 97 subregion model. This model was designed to provide inputs for traffic forecasting techniques being applied by EMRPP.

(b) Integrating the Testing of Land Use and Transportation Plans

The problem of when to forecast land use in a model, and when to hold land uses constant for varying transportation plans as a matter of "policy," poses definite methodological problems and requirements for this study. Several agencies, cities and private groups have now, or have had policies in the past on desirable future levels and distributions of activities in parts of the region. For example, MAPC, in their memo of August 25, 1970 state:

> "As in the case of the prior network analysis efforts of the Eastern Massachusetts Regional Planning Project (EMRPP) and the Task A traffic

study, the issues of the character and extent of future downtown Boston and inner core area economic growth, and the future population distribution merit careful attention as a basic factor in network analysis. Any major changes in previous assumptions relative to these basic data should be fully understood within the context of municipal and metropolitan policies and within the context of the possibility of attainment."

This quote sums up the problem very well. The last sentence alludes both to the importance of the policies on land development, and to the "possibility" of attainment, (and therefore non-attainment). Both aspects, must be accounted for in the work program of this study.

D. Testing Land Use Policies

1. Benefits

The non-user benefits that are usually thought to be relevant from transportation improvements are increased economic development, increased land values due to increased accessibility, increased tax base, etc. However, if population and employment totals for the region are assumed to remain constant, any such population and employment differentials must be treated as transfers within the region. Thus in terms of aggregate benefits they can probably be ignored. Similarly, increased land values from increased accessibility should be ignored since they reflect transport (time, etc.) savings. To include them would involve double counting. However, if non-user benefits can be ignored in the context of measuring aggregate benefits, they cannot be ignored when questions of the distributions of the benefits are considered. Which cities, towns and neighborhoods gain employment relatively or absolutely; which enjoy an increase in their tax base; which undergo a general inflation of land values because of increased accessibility? These are questions that affect the sentiment for or against specific transportation improvements among the study participants. To the extent that certain distributions of these benefits are favored by the study participants, they have importance in this study. Future levels of population, employment and

retail sales, etc., resulting from alternative transportation program packages are thus an important criterion in evaluating alternative plans. Their use may have been limited across the country in transportation planning to date, because the groups to whom they are most important, namely, a wide cross-section of communities and private groups, have had a limited role in formulating and evaluating transportation improvements.

It, therefore, appears important to heed the words in the memo of the Municipal Caucus (Sept. 9, 1970):

> "That all transportation plans be based upon a previously agreed to set of land use goals, and socio-economic and ecological criteria. The alternatives could be tested against these goals and criteria to determine how well the particular transportation system served the proposed land use arrangements. If it was determined that the transportation pattern alternative did not meet the land use goals and other criteria, the alternative would be further studied to determine: 1) What changes would be necessary in the transportation pattern to meet the land use goals and other criteria or; 2) how these particular goals and criteria should be modified."

2. The Question of Testing Alternate Land Use Plans

Several cautionary statements may be given as reasons to modify somewhat an initial assumption of a single land use plan as the basis for testing all transportation plans. These are:

(a) Analysis may show that existing land use policies for particular municipalities are unrealistic and unlikely of achievement when viewed from the regional perspective in terms of pervasive land market forces. Such analysis may give sufficient evidence upon which to base the adoption of substantially different land use policies.

(b) The sensitivity of travel and other impacts (pollution, etc.), to changes and uncertainties in activity distributions may influence the importance of these impacts in the evaluation phase. Separate travel forecasts based on high and low ranges of activity distributions would be needed to evaluate this sensitivity.

(c) The flexibility of transportation program packages to service different land use plans has been viewed by study participants to be an important evaluation criteria because of the uncertainties of achieving any land use plan.

(d) It may be difficult to get agreement on a single land use plan for testing.

There would appear, at least for methodological reasons, to be a mandate to test two or three land use policies. The next step is to indicate how they are to be tested.

Work Program

A. Phase I Analyses: Land Use Distribution

High and low ranges in core area forecasts will be used as the basis for travel forecasts carried out to equilibrium. The selection of the high and low ranges will be aided by sensitivity analyses using EMPIRIC model calibrated co-efficients and expert professional judgment on the degree to which alternative transportation program packages encourage or discourage growth in the various parts of the Boston Region. The low range "forecasts" will be based on previous EMPIRIC forecasts modified as per the three step manual process below. The expected change in land use patterns resulting from the sensitivity analyses will be used as an evaluation measure. The high range distribution is likely to be based more on policy goals than on what model sensitivity analyses can produce. This is necessary if information is to be brought forward to the ends of the uncertainty range as to the magnitude of the tradeoff between a transportation system needed to promote and serve a part of the region (e.g. downtown Boston) and the disruption that system may cause.

(a) Adjustment of the original land use forecasts as they came out of the computer to reflect the effects of variables not explicitly included in the model--e.g., urban renewal, educational institutions, zoning controls, etc.

(b) A sensitivity analysis adjustment of the land use forecasts in time stages to 1990 to reflect the changes in policy variables (notably transportation), between those used for the original forecasts, the transportation improvements that have actually been implemented by 1970, and the future "low range" alternative transportation program packages to be tested.

(c) Comparison of 1970 predicted land uses adjusted in step(b)with observed fact. The pattern of discrepancies between 1970 predicted (as adjusted in step (b)and observed will be analyzed and adjusted accordingly. The differences will be mapped to detect what variables are causing significant deviations. The differences will then be plotted against these variables to determine modifying relationships (to be applied manually) to those contained in the model. For example, relationships may be different in the suburbs and in the more densely populated cities between car ownership and family income growth.

Step (b) and (c) would be repeated for the probable high range program package to produce the evaluation information noted above and to educate our judgment as to the probable land use consequences of alternative transportation plans. As noted before, the results would illuminate, but not necessarily constrain, the high range "policy goal" land use distribution. Also, if warranted by discrepancies between 1970 regional totals used in EMRPP and Task A and those from the Federal 1970 Census, the regional totals may be modified or varied for future years. This will be carried out in conjunction with the studies on the effects of alternative program packages on the regional economy. (It should be noted here that EMPIRIC is not a regional growth model, but a subregional activities allocation model.)

B. Phase I Analyses: Travel Forecasts

Approximately four to five equilibrium time staged (1970,80,90) travel forecasts (not equilibrated with land uses) would be carried out during the initial analysis stage. Two or three of these would be based on the low range land use distribution, and two on the high range distribution. The table below illustrates the proposed testing scheme:

		Transportation Package		
		A.	B.	C.
Land Use Range:	Low	x	(x)	x
	High		x	x

The circled x is the test which might be omitted. The lettering scheme A, B and C is a progression from those program packages likely to promote the "low" land use range, to C which tend toward the high range. However, C will most likely not be consonant with the high or "policy" land use forecast, as noted above.

If for some reason the "policy" forecast is between A and C, and is substantially different from B, the fifth test and possibly even a sixth test should be based upon the policy forecast using a transportation system (D) designed such that its expected land use effects (combined with other effects) approximated the policy goal.

The travel forecasting will use demand estimation with the cross-elasticity model and will make use of MIT's DODOTRANS equilibrium assignment package run on the MBTA's computer at an aggregation level of roughly the 97 zones used for calibration of both an EMPIRIC model version, and the cross-elasticity model. DODOTRANS loads successive increments of the total demand on the total transportation system. The traffic volumes on each route section of the transportation system are used to find the speeds at which demand is loaded. The operating speeds are then used in repeats of the process the necessary number of times until the travel times and costs used to forecast the traffic flows are in equilibrium with (i.e. equal to the) travel times which result when the total traffic flows are loaded on the route sections. It is at this stage that equilibrium has been reached and realistic traffic flows have been forecast.

The important step of bringing the travel times and costs output from the travel forecasts into consonance with those used to "forecast" the low and high land use plans at each forecast year will not be carried out because of calendar time limitations. However, the extent to which these resulting travel conditions match the conditions under which the low and high range forecasts were made will be an important index of the success of the program packages in having the desired effect on system related (operational) and metropolitan land use goals. Also, substantial "selected links" output will be obtained from these forecasts to show the functions and groups served of all major transportation links of interest.

A series of reviews and adjustments will be made to all travel forecasts to account for special conditions not accounted for in the model. An example of concern to the Municipal Caucus is the realistic ceiling on auto use and travel which must be placed on residents of very dense areas where parking and other conditions are severely restrictive.

C. Phase I Analyses: Special Studies of Existing Travel, Possible Ranges of Modal Usage and Bottleneck Analysis

To aid in the process of narrowing alternatives, special studies will be carried out in Phase I which permit fine-grain analysis in the areas affected by the major options

open to the Study. The following analyses will achieve the objectives defined previously in the subsection titled Approach, C, "Need for Design Ability":

1. Compiling and mapping 1963 Home Interview Survey trip ends and trip interchanges by mode, purpose and time period for large and small areas of interest.

2. Compiling and analyzing travel behavior by various groups in society to better understand trips not made, and how good transit service affects travel by certain low income or transportation deprived groups.

3. Manual and judgmental analyses of the 1990 Task A forecasts to help determine the functions expected to result by 1990 of the major existing and proposed links of interest in that network. The analyses to be directed toward such questions as (a) whether the links are in the best place to carry the type and function of traffic which has been assigned to them, and (b) whether the pattern of build-up of loadings (i.e. density gradients) lead to possibly different network configurations and scale from that tested.

4. Manually conducted sensitivity analyses using the policy sensitive model of possible ranges of travel by mode, and purpose between parts of the region, with wide variations in the transportation network and the service supplied.

5. Manually conducted bottleneck analysis to examine the operational feasibility of critical interchanges, bridges and major tightly interrelated highway complexes in the core area. The results of this bottleneck analysis will be used to augment in detail the traffic assignment results and to feed back into the design process any changes in the system which this analysis suggests. (See November 9, 1970 memorandum by S. Kaiser, pp. 12-15, for a suggested schematic approach to bottleneck analysis.)

D. Phase II Analyses: 97 Subregion Forecasts

1. Land Use/Travel Equilibrium

Any failures found in the Phase I analyses on the part of the transportation program packages remaining as possible options to provide the proper measures of service on which the land use plans were based must be remedied; that is at each forecast year an equilibrium must be achieved between

the transportation service levels used to predict land use, and those which result when trips to and from those land uses are loaded onto the transportation system. Otherwise, inadequate measures of whether a transportation plan both services (i.e. with "acceptable" travel conditions) and promotes a land use plan will result. The forecasting process must therefore provide a systematic representation of the anticipated sequential stages of development of the region under the influence of the program packages.

This will probably require running the EMPIRIC model on the computer. However, solving the set of linear forecasting equations systematically on the computer for 97 subregions is inexpensive. The normally time consuming part of running EMPIRIC is coding travel times on the transportation networks.

These networks will be coded for input to the travel forecasts, and the resulting travel times will be output automatically from DODOTRANS.

2. Additional Travel Forecasts

It will likely be necessary in Phase II to provide for several runs of the cross-elasticity model as the process of narrowing and redesigning alternatives proceeds throughout the study. The forecasts for alternative packages will be made in response to new information on values and preferences as participants are confronted with the consequences of alternative plans at the regional level in terms of travel flows, quality of travel, and achievement of particular land use and social goals relating to the distribution of population and jobs.

3. Bottleneck Analysis

The analysis described above, subtask C(5) of the work program, will be repeated or revised as appropriate for critical areas of congestion for each alternative system for which assignments are made at the 97 subregion level in Phases I and II.

E. Phase II Analyses: Detailed Plan Testing

As noted in "Approach, B, 2, Scale and Detail," the emphasis and detail given to the planning of transportation improvements should vary with the time horizon of the project.

An immediate improvement calling for an immediate decision is politically and economically far more important than projects built 10 and 20 years hence. This does not diminish the importance of testing at lower levels of detail full alternative transportation systems at remote target years for fulfillment of system related and metropolitan land use goals. These are the analyses described above. However, the detailed plan testing, because of time and money limitations should and will be limited almost exclusively to short term time horizons (e.g. 1975). The availability of the 1990 Task A forecasts is another reason for avoiding a 20 year time frame. The latter is useful for comparison purposes also, providing consistent forecasting techniques are used. However, the comparisons must be made with care to account for all differences in inputs (land use policies and transportation system descriptions) and adjustments made to account for 1970 actual land development.

It is proposed to carry out the following tasks: the first is that outlined as #3 in "Approach, C, Need for Design Ability."

1. Carry out detailed (626 zone) capacity restrained assignment consistent with Task A procedures of both 1963 home interview survey trips and 1963 synthetic Task A model trips, and possibly cross-elasticity model trips with substantial "selected link" output to show the function (locations of origins and destinations, groups served, etc.) of all existing major transportation links of interest. The output would also be compared with ground counts. Additional purposes of assigning the modeled trips would be both for link volume comparisons with the 97 zone assigned volumes (reducing uncertainties) and for analyzing trips not made. That is, the "synthetic" models produce and assign trips on the basis of regional "norms" and usual response to travel conditions. Variations in travel from these norms will help indicate the presence of unusual conditions, and suggest solutions and improvements. The variations will also indicate where the detailed regional level models are inadequate for further neighborhood or other analysis purposes.

2. Use the Task A Models, or the cross-elasticity model (depending on the results of 1) to predict travel at the 626 zone level in 1970 or 1975 based on 1970 existing or 1975 predicted land uses. The assignment program would be the CDC Tran Plan program for consistency with step 1, unless previous DODOTRANS work

at the 97 zone level showed the technique to be capable and efficient at the (presently untested) 626 zone level. The systems to be tested at this detailed level would be greatly limited in number (one or two) and would be tested for only one point in time for economy reasons and because the "time series effects" (trends) would be amply demonstrated from the system tests at the 97 zone level. Also some 1990 detailed forecasts are available, as noted above.

The networks to be coded for testing purposes in this step would benefit from the previous Task A and Step 1 analysis work in the sense that improved definitions could be made of capacities and traffic operations on ramps and in critical intersections. These capacities are a function of intersecting traffic, but they must normally be coded in advance of knowledge of what the intersecting traffic volumes will be. A better "handle" on these capacities is thus possible the "second time around." This should help to alleviate problems in this controversial and highly important area of impact of program packages on surface street operations. Also, improved knowledge of truck movement on this "second time around" will allow a better accounting of the effect of truck loadings on highway and intersection capacities. That is, large trucks are the equivalent of more than one passenger car in the way they affect capacities of streets and highways. This must be accounted for in the coding of capacities of the streets and highways in the systems to be tested.

STUDY ELEMENT 7

Special Mobility Studies

While a major focus of this study will be on decisions regarding major metropolitan transportation facilities, it is recognized that there exist significant transportation deficiencies that will not be resolved and in fact could be worsened by investments in regional expressways or rapid transit lines. The objective of the tasks outlined in this Study Element is to assess the demand and develop requirements for transportation systems to meet previously unmet or latent needs, with particular reference to especially disadvantaged groups, e.g. autoless households, unemployed, disabled, elderly and young people.

Although by no means all inner-city residents fall into the category of disadvantaged, there are nevertheless significant concentrations of such groups living in and around the core of the metropolitan region, and it is these areas that bear a significant proportion of the negative impacts resulting from the construction of major transportation facilities.

In approaching the problem, it is important to note that despite considerable publicity and the funding by DOT and HUD of a number of demonstration projects, the relative importance of transportation in contributing to inner city unemployment is not precisely known. However, access to transportation undoubtedly plays a significant role in many cases as a necessary but not sufficient condition for achieving a range of social goals.

While there are very many aspects of the relationship between transportation and social goals that could and should be explored, this study will focus on estimating the demand for:

1. Special services to hospital clinics, job training centers, community facilities and other centers identified by potential users.

2. Special services to outlying and crosstown job centers for job seekers and commuters from high unemployment core communities.

3. Substantial improvements in regular local transit (coverage intensive transit) to other high activity centers, including concentrations of core area employment.

Considerable coordination with other Study Elements will be required. Demand data developed in S.E. #6, Land Use and Travel Forecasting, and S.E. #13, Business Relocation and Employment will

be integrated with data collected as part of this Study Element. The design of relevant transportation solutions will be performed under S. E. #4, Transportation System Design, with input from S.E. #8, Technological Planning. S. E. #14, Neighborhood Cohesion and Transportation Needs, will identify special local transportation problems in potentially impacted neighborhoods, and will likely include attention to certain local access problems which must be integrated with this Study Element.

Two guidelines have been followed in the formulation of this Study Element.

1. There is consensus within the Steering Group and Working Committee that large scale, sophisticated home interview surveys are neither needed nor justified as part of this study. The preferred formats for data collection, survey and evaluation should be simple, flexible, responsive to unique situations, and in appropriate situations capable of being performed by community groups under the guidance of professional staff.

2. It is important that decisions and actions should be seen to flow from the planning and data gathering activities that will occur within the neighborhoods. Demonstration projects, commitment of capital funds and improvements in the quality of existing services will all be effective in demonstrating the value of constructive public participation in the transportation planning process.

Tasks to be Accomplished

A. Definition of areas to be covered by major service improvements

An MBTA staff member has proposed six alternative ranges of geographical coverage: 1/

(a) Full and even coverage within Route 128 without discrimination by density pattern.

(b) Superior coverage for entire area within Route 128 but discrimination of rates in relation to costs of servicing.

1/ Memo from Matthew Coogan to MBTA planning staff on "Definition of Coverage Intensive," September 30, 1970.

(c) Full inner cities service

(d) Concentrated inner cities service along intensive corridors

(e) Full service within core area roughly as defined by proposed Inner Belt alignment

(f) Core, but mainly CBD spine

A more limited number of alternative study areas will have to be defined, based on analysis of current deficiency of service, previous studies of special mobility needs of the Boston area, available data on the locational patterns of autoless households and others whose mobility depends on public transportation, and on data indicating where potential demand is likely to be most responsive to new and improved service.

B. Establish overall program for area and neighborhood based studies

Based on the preliminary definition of study areas, and an initial investigation of local issues, the consultant, working with local residents, will set up a series of local surveys to analyze local needs for special services. Concurrently, the staff will coordinate with those related areawide studies, in particular coverage intensive transit design (part of S.E. #4) and travel forecasting (part of S.E. #6).

C. Execution of local surveys

Local surveys will follow methodology based on experience gained from recent related studies in other cities for Model Cities and UMTA's service development demonstrations. These include the conduct of a number of relatively simple, inexpensive surveys at the destinations of "essential" trips, e.g. employment centers, clinics, hospitals and shopping areas. The output from these surveys would indicate the area of service of a given institution, the gaps in the area of service, information on patterns of use, frequency of visits, methods of transportation, cost, travel time, user perceptions, quality of service and suggestions for improvement.

Follow-up surveys, interviews and analysis would be designed and executed based on the findings of the Phase I surveys to refine the identification of new service needs and test preliminary responses to potential new services.

D. The design and evaluation of transportation solutions

The design of alternative system improvements is covered in S.E. #4, Transportation System Design. It will include new systems (demand actuated transit, jitney services, dial-a-bus) as well as major improvements in the operation or level of service provided by existing transit, streetcar and bus systems. Recognition will be given to the role that is played by, and could be played by the taxi system.

Because of the nature of some of these new systems and problems associated with the above work, some of these alternative system designs may not be integrated into the program packages until Phase II when they can be meaningfully designed to serve defined needs. An integral part of the study process will be to use the data developed in the study to develop demonstration project plans.

All alternative program packages including but not limited to those components described above will be evaluated from the standpoint of the concerns of this Study Element. The relevant criteria of Section IV which have thus far been defined and assigned to this Study Element include:

Transportation Service:

C. Access provided to employment, educational, commercial, medical, cultural, social and other public and private facilities, services and amenities.

D. Reliability of reaching destinations within time preferred (includes dependability of equipment, of flow, etc.) aesthetics, effects of congestion.

M. Service provided for previously unmet or latent transportation needs, recognizing that "demand" for transportation is a function of the transportation service available.

STUDY ELEMENT 8

Technological Planning

Metropolitan transportation planning in Boston, as in other areas has given little attention to technological innovation. The view that has usually been taken is that no major new systems are likely to be introduced which will replace or significantly affect demands for current auto and transit technology within the next two decades and that therefore reliance must be placed upon improvements and expansions to these existing systems. Moreover, individual urban areas do not have the resources for significant R & D in new systems.

A contrary view is taken in this study -- that technological innovation should be consciously planned for. In the past no State or local agency has had this responsibility. However, participants in this Study Design have clearly expressed a desire for change. The new Massachusetts Department of Transportation and Construction will be expected to play a leadership role in technological planning, and to seek common cause with other states and the U.S. Department of Transportation in promoting the development of new systems, components and construction methods promising the greatest benefits. Studies already completed indicate that several new technologies can be expected to be implemented and yield substantial advantage over current technology within the relatively near future (well within planning horizons for current investment decisions), if the commitment to their development is made. This study should work toward that commitment while insuring that current decisions and designs for facilities constructed now are adaptable to accommodate new systems.

Methods of Analysis

During Phase I the literature of technology will be reviewed for application in this study. This literature includes HUD's "New Systems" study, subsequent work sponsored by UMTA, various studies of potential demand for new systems conducted at M.I.T. and elsewhere, recent studies by Dan Brand at M.I.T (on dual mode system requirements with particular reference to Boston) and an unpublished study conducted in the Office of the Secretary of D.O.T. (on the markets for, and expected time required to complete R & D for most promising new systems). These reviews will be guided by the design and evaluation criteria contained in Section IV of Part One. Particular mobility needs, social, environmental and land use consequences will be given

proper attention in addition to economic and technical factors. Guidance will be sought from participants before preliminary findings are developed.

Emphasis in all of the work of this Study Element will be given to how technological innovations can be accommodated, prepared for or otherwise integrated with near term decisions and designs.

Early reviews and discussions with participants have indicated that attention should be given to short term innovations including twin-propulsion rail transit trains which can operate on both electrified and non-electrified track (MBTA has planned a demonstration project), dual mode buses which can operate on electrical power in subways, and dial-a-bus or other variations on demand-responsive transit.

Participants have also requested a review, directed toward local application, of new lower costs design and construction techniques for (a) tunneling (reference has been made to methods used in Milan) and (b) depressed highways in high water table areas (reference to methods used in Chicago).

Longer term innovations of identified promise include automated small vehicle transit guideway systems and dual mode (on/off) guideway systems. Although these latter systems are generally believed to be ten years or more in the future, if analysis shows that substantial benefits may accrue to the Boston area the results of this study might be used to substantially accelerate research and development at the national level. One of the primary purposes of the review of longer term innovations is to determine what, if any, design changes might be necessary to assure future adaptability of facilities to be built in the near term.

Analysis work to be conducted as part of this study will not duplicate work conducted by the U.S. Department of Transportation. Results of previous work by all others must be made use of and adapted as necessary to fit the context of this study and specific Boston area conditions, problems and objectives.

The assumptions regarding demand, system characteristics, costs and other critical factors in various previous studies will be reviewed and modified as necessary to provide initial evaluations of the merits of introducing new systems and components into the Boston area transportation system at the earliest dates feasible. These results will be used to modify sketch plans being developed for Phase I alternatives and will be input into the evaluation process of alternative systems.

The form of the inclusion of new systems and components into program packages will vary depending on the degree of uncertainty of expected availability dates, the magnitude of change expected to be affected by the innovation and other considerations. Evolutionary improvements in vehicles which are of high certainty of achievement by a near term date and which will result in rather modest, but definitely positive benefits, could be directly incorporated in all alternative systems, with a specified schedule for implementation and could be treated in the evaluation process in the same manner as other conventional system components. Also the most promising new inter-city ground transportation systems will be studies to develop requirements for the design of the Southwest corridor and possibly the third harbor tunnel to insure future adaptability (see discussion of this in Study Element #4, Transportation System Design).

At the other extreme, for example, the introduction of a metropolitan network for a dual mode, automatic, small vehicle guideway system involves considerable uncertainty in timing and vast changes in travel demand (including latent demand), effects on land use, effects on the existing and planned improvements to existing highway and transit systems, and therefore vast effects on the evaluation of any alternative regional system into which this new system would be introduced. Therefore a new alternative sketch plan might have to be developed with appropriate changes in design of existing system improvements, forecasts of traffic etc. Other less dramatic innovations might be handled as subalternatives for which new systems or components are treated as substitutes for portions of alternatives based on current technology; evaluation would be based on adjustments to only portions of the data (travel demand, land use, environmental effects, etc.) of the alternative system being modified.

During Phase II the methods of design and evaluation of new technology will proceed as extensions of the type of work planned for Phase I. That is, it will be unnecessary and impractical to carry these studies to a level of detail equivalent to that for Study Element #4, Transportation System Design, i.e., preliminary design and preliminary engineering. Rather, Phase II will involve iterations of modifications to sketch plans, specifications of design requirements to insure adaptability of current construction of existing systems and refinements of estimates of criteria needed to develop greater confidence in the expected benefits from introduction of new technology.

For near term innovations which involve applications of existing technology or minor modifications thereof, the Steering Group and Working Committee may recommend immediate conduct of a demonstration. If such a decision is reached at the end of Phase I or early in Phase II, the study staff may be asked to

assist the responsible agency in developing plans for the demonstration project (see Study Element #4 on preparation of demonstration projects for special transit services).

For innovations involving investment in research and development, decision by the Steering Group and Working Committee to recommend pursuit of that innovation may be made during the course of the Study, but the staff of this Study will not be expected to develop a work program for the required research and development. Results of analyses conducted, however, may be useful in identifying promising markets for the new technology and hence other units of government or industry who should have common interest in the R & D investment.

STUDY ELEMENT 9

Administrative and Legislative Studies

The principle objectives of this Study Element will be to:

1. evaluate the legal feasibility of carrying out alternative program package recommendations under current law and administrative policies;

2. consider various models for an administrative framework to implement proposals; and

3. to identify and consider changes in state and local law and administrative procedures that might be required to effectively implement study recommendations.

Although precise descriptions of administrative and legislative study activities are difficult to define before the study begins, several functional areas which will need attention have already been identified:

1. Administrative cooperation and delivery systems.

2. Feasibility of implementing program packages.

3. The participation process.

4. Existing and proposed state and Federal legislation and administrative regulations.

Each of these is described below.

Administrative Cooperation and Delivery Systems

A fundamental principle of the "program package" concept is that a varying number of municipal, state and Federal agencies can be coordinated into a coherent delivery system capable of providing funds, staff services and monitoring functions on an integrated basis, in a specified time frame. In many cases these agencies may also have the ultimate responsibility for the construction and maintenance of various specific facilities such as transport elements, joint development projects, relocation and so forth.

The success of this interagency coordination will be vital to the effective implementation of decisions developed from the Boston Transportation Planning Review.

In relation to the coordination of municipal, state and Federal agencies, study tasks will include:

1. Analysis of the capacity of existing administrative structures to coordinate and deliver the elements of the alternative program packages.

2. A review of the Governor's Task Force recommendations and other existing responses, reviews and draft legislation relating to the Boston regional transportation planning process.

3. An analysis of the role and responsibilities of the reorganized agencies under the Governor's Cabinet Act of 1969 in relation to transportation planning.

4. The development of alternative models for joint decision making as between agencies in relation to the delivery of program packages.

5. An examination of the role of the Secretary and the State Executive Office of Transportation and Construction in the design, review and implementation of program packages.

Feasibility of Implementation of Alternative Program Packages

The evaluation of certain questions of feasibility relating to specific elements of program packages such as replacement housing (S.E. #12) or Joint Development (S.E. #5) will require the staff to work closely with those responsible for work in that area.

The general criteria (from the list of all criteria in Section IV of Part One) for which this Study Element has responsibility are:

. . . Ease and feasibility of implementation for both immediate and longer term parts of the program packages.

. . . Acceptability to Federal, state and local governments.

. . . Acceptability to affected private organizations and neighborhood groups.

. . . Statutory, legal and administrative changes necessary for implementation.

Specific aspects of ease and feasibility of implementation which will be addressed include:

1. Funding

Funding sources will be examined for each of the alternative program packages identified, including existing Federal, state and local sources. An attempt will be made to identify "new" or previously untapped sources of revenue for alternative program packages.

The examination of funding will include the extent to which existing funds are committed, the limitations set by the source for use of the funds, and the availability of new funds for elements of program packages for which earmarked money is not presently available.

In the event that parts of the presently designated Interstate system are recommended for elimination, or for construction as facilities which do not meet Interstate system design standards, or in the event that expressways in entirely new corridors are recommended to replace parts of the designated system, then the question will arise as to the extent to which the various components of the recommended system can quality for Interstate system financing under Federal law and regulation.

Federal-aid highway law 1/ and the legislative history pertaining to this issue will be reviewed to develop legal criteria for qualifying an expressway as part of the Interstate system. Files of the Federal Highway Administration on any previous related legal reviews or decisions will be used. These reviews will be conducted during Phase I so that the resulting opinions and criteria can be used in all phases.

Results of these reviews will be used during the sketch planning work to determine if possible modifications might influence the feasibility of Interstate system financing. The evaluation of all alternatives will include an estimate of the probability of qualification of each expressway component, the factors upon which the decision would rest; and a recommended basis for seeking approval. (See subsection below on "Review of Existing and Proposed State and Federal Legislation...")

1/ Title 23, United States Code, Sections 101, 103, 107, 111, 139, and other relevant sections.

2. Governmental Cooperation Aspects of Alternative Program Packages

The development of alternative program packages with differing mixes of transportation elements will require an intense degree of cooperation and coordination among governments and agencies at all levels, and probably the private sector.

Assuming the development of one or more program packages on which broad consensus can be achieved, the process will test the ability of government to respond to the needs and desires of its citizens.

The full implications cannot be measured until alternative program packages can be developed. It is obvious, however, that the planning, design, construction and operation of mixed-mode transportation facilities and services will require the close cooperation of highway and transit agencies at the State and Federal level. Additional elements of a program package almost certainly will require the intense cooperation of local governments and agencies and probably Federal non-transportation agencies.

It can be expected that full implementation of a program package will require new or modified policies which can be adopted only with the cooperation of the Governor and Mayor(s) and the General Court and one or more local councils or boards of selectmen. Differing policies, priorities, assignments of resources, time phasing and other factors will have to be accommodated.

The Participatory Process and the Boston Transportation Planning Review

The participatory process is a unique approach to community involvement in transportation planning and decision making. Thus its relationship as a formal procedure to both State and Federal regulations will be a discrete area of study. Specifically the relationship of the process to the following will require some analysis:

1. Federal and State laws, with particular reference to hearing requirements.

2. Federal and State administrative policies and procedures.

Although the form and responsibility of the Steering Group convened by the Governor's representative has been broadly defined for the period of the Study Design and the full study,

attention will be given to the definition of an ongoing participatory structure during the continuing planning process and during the implementation of decisions and the construction of facilities. Included will be legal or administrative policy requirements, timing, and other factors which provide for optimal public involvement without stifling decision making or implementation.

Review of Existing and Proposed Legislation Relating to Transportation

Many aspects of the foregoing analyses will require research on existing legislation and case law. In addition to these tasks, special attention will be given to the following:

1. The relationship of existing and proposed state laws to the 1970 Federal-Aid Highway Act, with reference to the implementation of program packages defined in the study.

2. A review of existing state legislation pertaining to the following aspects of transportation:

   (a) Eminent Domain procedures.

   (b) Protection of adjacent property during demolition and construction.

   (c) Joint Development capabilities.

   (d) Authority to coordinate parking policy with other aspects of urban transportation policy.

   (e) Authority to develop replacement housing.

From the findings of the above special reviews, and the results of other tasks described above in this Study Element, all gaps, weaknesses or hinderances to effective implementation which presently exist in either state law or local ordinances will be identified. The most feasible and desirable manner of correcting existing laws and ordinances, or of making necessary changes, will be devised and recommended. New legislation will be drafted as necessary in cooperation with appropriate staffs and officials.

STUDY ELEMENT 10

Environmental and Conservation Studies

Understanding of the precise nature of environmental consequences and their relationship to highway programs is still in the formative stage. However, the fact that some environmental factors are not susceptible to quantification in the same way as engineering or economic activities does not make the task either irrelevant or impossible -- it merely means that hard numbers are replaced by criteria, standards and procedures that allow full accounting.

Broad public support for the maintenance of environmental quality is recognized, and the spirit and intent of the National Environmental Policy Act of 1969 clearly indicates a commitment by the Federal Government to the rigorous application of protective guidelines and procedures to all federally supported programs that affect environmental and social quality. In Section 102, Congress states:

> "The Congress authorizes and directs that to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall --
>
> "(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment;
>
> (B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical consideration..."

The preservation of parklands, open space and wildlife refuges is declared a national policy in Section 138, Federal Aid Highways, Title 23, U.S.C., "Preservation of Parklands."

> "It is hereby declared to be the national policy that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites. The Secretary and Transportation shall cooperate and consult with the Secretaries of the Interior, Housing and

Urban Development, and Agriculture, and with the States in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands traversed. After the effective date of the Federal-Aid Highway Act of 1968, the Secretary shall not approve any program or project which requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state or local significance as determined by the Federal, state or local officials having jurisdiction thereof, or any land from an historic site of national, state, or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreational area, wildlife and waterfowl refuge, or historic site resulting from such use."

A central objective of the study process will be to develop plans and evaluation procedures that comply with and implement these Federal policies and which address the specific criteria relating to environmental and conservation issues listed in Section IV of this report. (see also Figure IV.1)

To assist the staff in making qualitative judgments, an Environmental Advisory Committee will be formed with highly qualified, expert, professional, interdisciplinary local representation. This Advisory Committee would have responsibility both in supplementing existing published sources of information relating to environmental and conservation issues, and acting as an external review board for the various iterations of design and evaluation.

Special attention will be given to the identification of those situations where land or activities which are affected by alternative program packages can be protected (or even enhanced) by special design features.

Thus, emphasis will be given to the definition of opportunities where there is the need for the application of specific design solutions such as separating dual highways, constructing facilities in tunnels or the programming of joint development facilities within the transportation right-of-way. Attention will also be given to the environmental impact of land use changes occurring as a result of increased accessibility brought about by the construction of major interchange facilities ("mode mixers") or indirect effects such as an increase in commercial development at a highway interchange or transit station.

At all stages of the process, and particularly in the analysis and design stages, work in this Study Element will be intimately connected to the Transportation System Design work of S.E. #4, and to the integration functions of Study Element #5, Joint Development and the Development of Alternative Program Packages.

Work Program

The following tasks have been identified and will be described below:

. . . The development of inputs into the design of alternative program packages

. . . Collection of additional data and the review of existing material

. . . The evaluation of alternative program packages

. . . Recommendations for design specifications and implementation

1. The Development of Inputs into the Design of Alternative Program Packages

The design of the alternatives will be the major responsibility of Study Elements #6 and #5; however, certain initial data and design criteria will be needed, e. g. locational constraints, evaluations of certain key resources and so forth. Where transportation routes are adjacent to open space and environmental resources, certain special design parameters will be specified.

Within each corridor, an analysis will be made to determine the nature and spatial distribution of physical constraints that may affect the location of transportation alignments. These will emphasize environmental values such as:

(a) parks
(b) open space
(c) water resources
(d) natural wild areas
(e) historical sites
(f) structures of architectural value
(g) esthetics
(h) urban form

The alternative program packages will be drawn up in accordance with Section 138 of Title 23, U.S.C. (as quoted previously) which requires that the taking of open space, parks and environmental resources be avoided unless there is no feasible alternative.

Inputs to design work will continue throughout the study process.

2. Collection of Additional Data and the Review of Existing Data

The basic source of data on open space resources and parks will be the MAPC Open Space Plan (1969) and this will be supplemented by other published material, field surveys and advice from the Environmental Advisory Committee and local environmental, professional, and conservation groups. Use will be made of all relevant existing studies prepared for state agencies, such as the salt migration and noise studies presently being carried out for the Department of Public Works, and the computer model of the Neponset river watershed developed by the Massachusetts Department of Natural Resources to simulate relationships among water table levels, run off, and river flow rate.

Field surveys will be made to determine present environmental quality, including ambient noise and air pollution levels in affected corridors. 1/

3. The Evaluation of Alternative Program Packages

Minimum standards will be set for those criteria for which no acceptable level of performance presently exists. (see also tasks under S.E. #3, Use of Design and Evaluation Criteria).

The performance of each total program package will be evaluated against the criteria from Section IV (repeated below) which apply to this Study Element. The type of impact, e.g. noise, air pollution, interruption of ecological processes, visual intrusion, and so forth, will be evaluated with explicit attention to the character of the impacted area of activity--for example, residential neighborhood, historical area, wildlife refuge and so forth.

In the first phase of evaluation, qualitative interpretations of impacts will be made and for each program package explicit statements as to the degree and severity of these impacts will be developed. Evaluation will be carried out by the professional staff, aided by the Environmental Advisory Committee and other local, interested groups.

In Phase II and Phase III evaluations, the measurable elements of the impacts will be evaluated and explicitly defined by the staff and the Advisory Committee. All impacts will be categorized on a

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1/ While it is recognized that measures of environmental quality will be largely developed from a cross section of subjective qualitative assessments, there are systematic and quantitative methods available for application in certain areas. (e.g. see "Landscape Esthetics" by Luna B. Leopold, Natural History Magazine, October 1969, p.p. 37-44)

DPW. A Report to Governor Francis W. Sargent on the Status and Progress of the Highway Program, January 1-March 31, 1969; April 1-June 30, 1969.

DPW. Semiannual Report to Governor Francis W. Sargent on the Highway Program, July 1-December 31, 1969.

DPW. A Statewide Highway Transportation Plan: Program Costs to 1990, January 1969.

DPW. A Statewide Highway Transportation Plan; Road and Street Responsibilities, September 1968.

DPW. A Statewide Highway Transportation Plan, Financial Requirements to 1990, June 1969.

Massachusetts Turnpike Authority

Massachusetts Turnpike Authority. Preliminary Feasibility Study: Third Crossing Boston Harbor, prepared by Estabrook & Co., Coverdale & Colpitts, Sverdrup & Parcel and Associates, Inc. and Howard, Needles, Tammen & Bergendoff, June 1968.

North Shore Committee on Transportation

North Shore Committee on Transportation. North Shore Transportation Problems, prepared by Urban Planning Aid, Inc., Volumes I and II (Appendix), March 1970.

Cambridge Inner Belt

Bolger, Frances and McNamara, Laramie. "Cambridge Inner Belt" Spring, 1969

Harvard University, Graduate School of Design. A Study of the Inner Belt, Cambridge: Multiple Use and Joint Development, Richard W. Thompson and William Glass.

Urban Planning Aid. "Statement Regarding Recent Choice of Inner Belt Route through Cambridge," June 7, 1967.

Southwest Corridor

Robert Gladstone and Associates. Marketability Analysis for the Southwest Corridor Study Area, Phase I, February 1970.

Southwest Corridor Technical Committee. "Proposed Work Program for a study of the Southwest Corridor," by BRA and the Boston Model City Administration, September 1968.

Southwest Corridor (cont.)

Southwest Corridor Technical Committee. Southwest Corridor Study, prepared by Architects Collaborative with H.W. Lochner, Inc., March 1970.

State Legislation

Commonwealth of Massachusetts. Acts, 1969. An Act Establishing a Governor's Cabinet, Chap. 704.

S. 1513. "Act Establishing a Governor's Cabinet," Draft, 1969.

H.B. 5202. "An Act Establishing a Governor's Cabinet," with message of Committee on Modernization of the Executive Branch, 1969.

Commonwealth of Massachusetts. Acts, 1964. An Act Abolishing the Metropolitan Transit Authority, Establishing the Massachusetts Bay Transportation Authority, and Providing for the Acquisition and Maintenance of Mass Transportation Facilities and Services which shall be coordinated with Highway Systems and Urban Development Plans throughout the Commonwealth, Chap. 563.

H.B. 4540. "An Act Prohibiting the Department of Public Works from Laying Out or Constructing Any Major Highway in Part of the Commonwealth which has as its Perimeter Route 128," 1970.

S. 928. "An Act Establishing the Massachusetts Highway Code," 1967.

Federal Legislation

U.S. Congress. Department of Transportation Act, October 15, 1966, Public Law 89-670.

U.S. Congress. Federal-Aid Highway Act of 1954, May 6, 1954, Public Law 83-350.

U.S. Congress. Federal-Aid Highway Act of 1956, June 29, 1956, Public Law 84-627.

U.S. Congress. Federal-Aid Highway Act of 1962, October 23, 1962, Public Law 87-866.

U.S. Congress. Federal-Aid Highway Act of 1966, September 13, 1966, Public Law 89-574.

Federal Legislation (cont.)

U.S. Congress. Federal-Aid Highway Act of 1968, August 23, 1968, Public Law 90-475.

U.S. Congress. Housing Act of 1961, June 30, 1961, Public Law 87-80.

U.S. Congress. National Environmental Policy Act of 1969, January 1, 1970, Public Law 91-190.

U.S. Congress. Urban Mass Transportation Act of 1964, Public Law 88-365.

U.S. Congress. Urban Mass Transportation Assistance Act of 1970, October 15, 1970, Public Law 91-453.

Additional Material

Griswold, William E., The Urban Transportation Dilemma: An Operational Solution, Systems Analysis and Research Corporation, Revised 1960.

Institute of Contemporary Art. Design in Transit, 1967

Leopold, Luna B. "Landscape Esthetics," Natural History Magazine, October 1969, pp. 37-44.

Lynch, Kevin. "The City as Environment," Scientific American, September 1965, pp. 209-219.

Massachusetts Institute of Technology. "Community and Environmental Factors in Transportation Planning," MIT research proposal, March 1970.

Urban Planning Aid, "A Critique of Transportation Planning in the Boston Area," October 1966.

U.S. Department of Commerce, Bureau of Public Roads. Interregional Highway Report of 1944, 1944.

U.S. Department of Transportation, Federal Highway Administration. "Policy and Procedure Memorandum 21-19," January 17, 1969.

BIBLIOGRAPHY

(PART TWO)

STUDY ELEMENT 1

U.S. Congress. Urban Mass Transportation Assistance Act of 1970, October 15, 1970. (Public Law 91-453)

U.S. House of Representatives. H.R. 19504: Federal-Aid Highway Act of 1970.

U.S. Senate. S. 4418: Federal-Aid Highway Act of 1970.

STUDY ELEMENT 3

Southern Wisconsin Regional Planning Commission. Planning Report No. 7: The Land Use-Transportation Study, Volumes I, II, and III, 1965-66.

STUDY ELEMENT 4

Alexander, Christopher. Notes on the Synthesis of Form, Harvard University Press, Cambridge, Massachusetts, 1966.

The Freeway in the City, A Report to the Secretary, Department of Transportation by the Urban Advisors to the Federal Highway Administrator, May 1, 1968.

U.S. Department of Commerce, Bureau of Public Roads. Policy and Procedure Memorandum 20-8, Public Hearings, Federal-Aid Projects, August 10, 1956.

U.S. Department of Transportation, Bureau of Public Roads. Policy and Procedure Memorandum 20-8, Public Hearings and Location Approval, January 14, 1969.

U.S. Department of Transportation, Bureau of Public Roads. Policy and Procedure Memorandum 21-18, Urban Traffic Operations Program to Increase Capacity and Safety, May 28, 1970.

STUDY ELEMENT 6

Domenich, Kraft and Valette. Estimation of Urban Passenger Travel Behavior, paper presented at the Annual Meeting of the Highway Research Board, January 1968.

STUDY ELEMENT 8

Brand, Daniel. Dual Mode Transportation Systems: Analysis of Demands and Benefits in Urban Areas; and Development of Performance Requirements, Urban Systems Laboratory, MIT, 1970.

STUDY ELEMENT 10

Leopold, Luna B. "Landscape Esthetics," Natural History Magazine, October 1969, pp. 37-44.

U.S. Congress. National Environmental Policy Act of 1969, January 1, 1970.

U.S. Code. Title 23: Federal Aid Highways, Section 138, "Preservation of Parklands."

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Central Reproduction Services
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HE214 .B71 B747as

Boston Transportation
Planning Review. Steering

Study design for a balanced
transportation development

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